AMERICAN MACHINIST

December 11, 1940

Aluminum—*Readily coined, embossed and stamped, aluminum alloys have wide range of properties*

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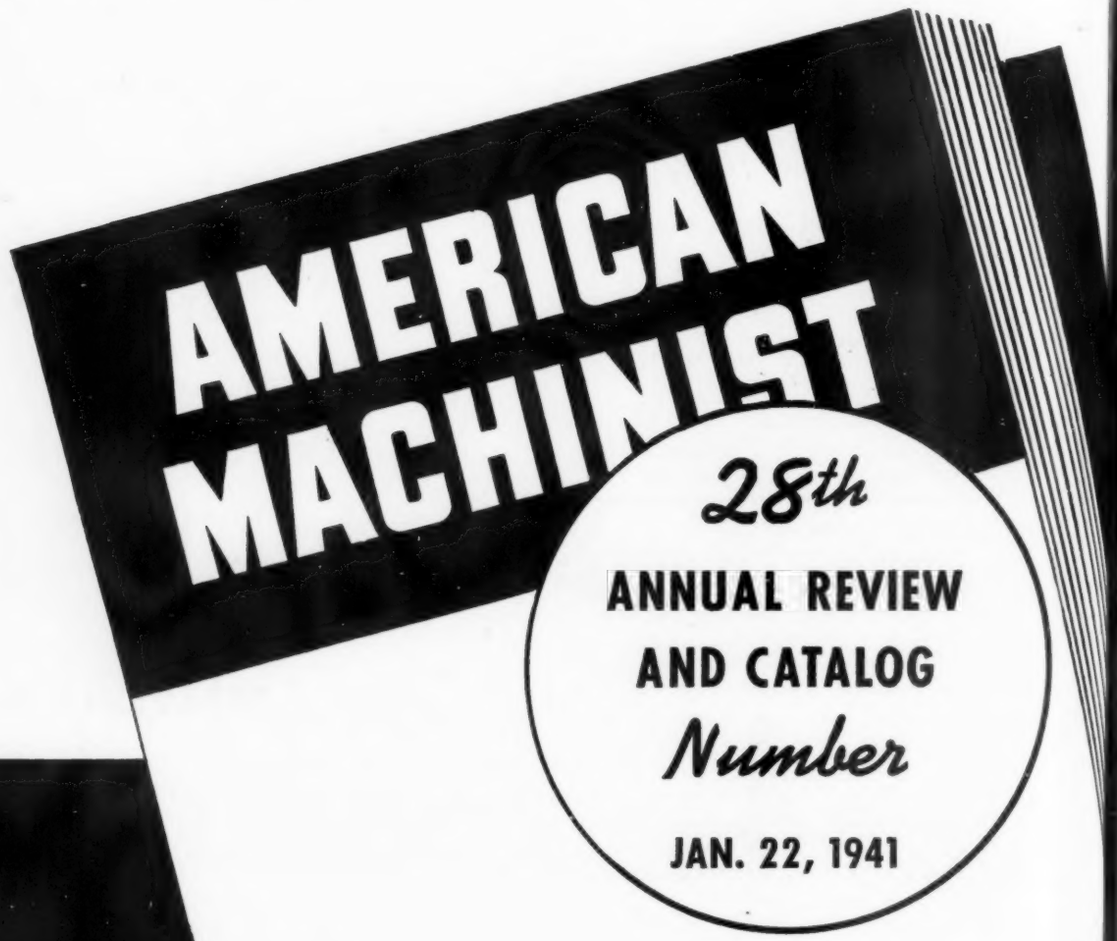


WHAT'S IN THIS ISSUE

ENORMOUS NAVY

You first hear about it when Congress begins to wrangle over it. You follow hot debates, take sides, become vastly relieved when a "two-ocean Navy" bill is passed. Then the papers forget all about it, as if the new ships were already launched, and get steamed up over something else. Maybe you do too.

No metal-working man needs to be reminded that it's years—two, three, four—from the appropriation to the finished ship, yet many of us lose sight of this fact. Acres of blueprints must be made. Reams of orders must be sent. Tons of complete assemblies must be manufactured. Materials requisitioned. Production planned. And so on.

One major ship component requiring considerable time to produce is the propulsion unit. Last month we reported on the manufacture of turbine gear reduction sets, and in this issue we describe one of the most important considerations in turning out the turbines themselves—the tooling. Beginning on page 1015 is a thirteen-page article on the tooling set-ups used in the New York Navy Yard for various turbine-making operations. It's in the Armament Section, of course.

OUNCE OF PREVENTION

We have long subscribed to the school of thought that maintains (to coin a phrase) that an ounce of prevention, etc. We don't seem to get very far spreading this particular gospel, but we've found one ardent supporter in A. H. Prey, of the Carborundum Company. Mr. Prey feels, among other things, that it's quicker and cheaper to sharpen cutters *before* they get dull. For further details, consult "Tips for the Cutter Grinder." It's on page 1004.

A. H. PREY
. . . before, not after

HIGHER

Higher production with higher accuracy is no new problem to aircraft people, but their individual solutions often exemplify an approach that can be used profitably elsewhere. Such is the case at Bendix Aviation, where the usual task of boosting output of small-lot parts held to close tolerances was accomplished by construction of special equipment. A down-to-fundamentals approach, and a knack for simplicity, resulted in additional advantages as well. Walter M. Schindler, Bendix production engineer, gives the details on page 1029.

W. M. SCHINDLER
. . . new aid for aircraft

ABOUT ALUMINUM

Two weeks ago we introduced to you L. J. Weber and J. T. Weinzierl, of the Aluminum Company of America, with the promise that they would soon begin a series on the cold working of sheet aluminum. A mere turn of the page brings you to the first article in this series. In it the authors outline general characteristics of aluminum and its more common alloys, and discuss heat-treatments for various methods and degrees of working.

E. JAMES
. . . works with welding

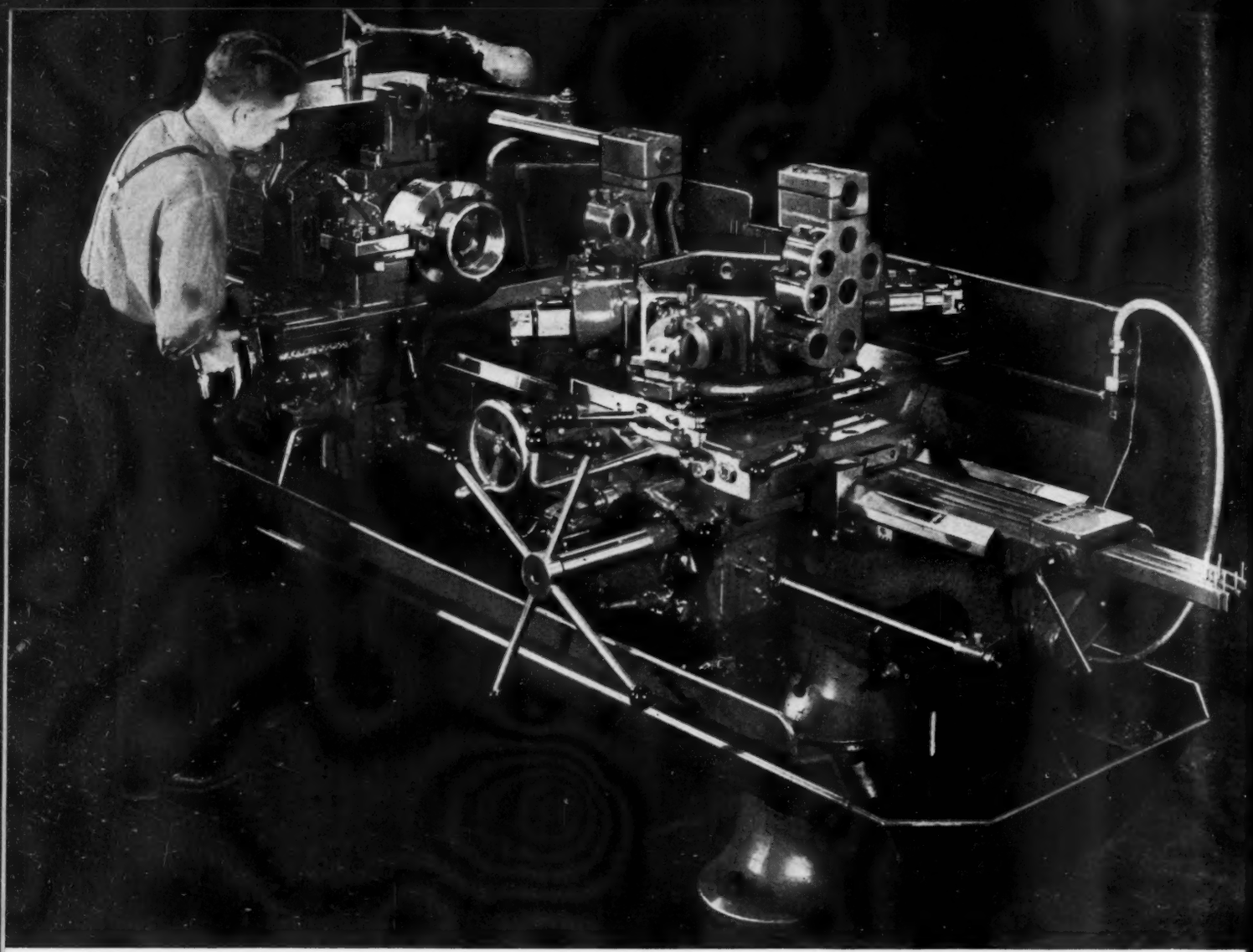
There'll be five more installments in the series, all as jammed with information as this one, so we respectfully suggest you start it now.

CAREER

Since 1926 E. James has been involved with welding operations on automobile body and chassis parts. He was a tool designer for Hudson, later tool engineer. He moved on to Briggs, then became a tool engineer for Budd. At Ford he worked in the body engineering section. At Packard he was first in charge of the die shop and model production, then fixture design and building. He has since taken over full responsibility for design and building of welding fixtures. Anticlimatic or not, he has also written an excellent article on the resistance welding of heavy sections, which you'll find on page 1008 of this number.

COMING

What's going on in Canada? What is the Dominion doing toward supplying Britain with vital war equipment and supplies? In our next issue we'll take you inside several Canadian munitions plants and reveal how ammunition and gun parts are produced. In an expanded Armament Section will be detailed many of the more important metal-working operations, complete with descriptions of much of the tooling. Look for the December 25 AMERICAN MACHINIST!



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ESTABLISHED 1877 AMERICAN MACHINIST BURNHAM FINNEY, Editor

THE COLD WORKING OF SHEET ALUMINUM—1

Two men with a hickory stick here are spinning a large aluminum-alloy container for an industrial plant. This process is important where production requirements are low

Available alloys

BY L. J. WEBER AND J. T. WEINZIERL, ALUMINUM COMPANY OF AMERICA

From a laboratory curiosity to a vital structural material—That's the story of aluminum. Much data for cold working its alloys is given in this series

ALUMINUM is one of the most workable of the common commercial metals. Available in all forms in which metals are produced, it is readily fabricated into a variety of shapes by practically every metal-working process. However, the metal-worker should not think of aluminum as just one material, but rather as a series of alloys which come in a wide range of tempers. The characteristics of these alloys affect shop practices and should be thoroughly understood.

While much is known about these alloys and the metallurgy of aluminum may be called a science, metal-working is more in the nature of an art. Especially is this true in the case

of spinning where the "feel" of the spinner is highly important and the spirit of the artisan is much alive.

Whenever aluminum or any other metal is worked cold—whether in making a basic commodity, such as sheet, or in later fabricating operations—strain hardening takes place. During the manipulation of the metal, the tensile and yield strengths are increased and the elongation is lowered. How these mechanical properties vary for the various tempers in the different alloys is shown in Table I.

The three properties mentioned serve as an indication, though not as an absolute measure, of the workability or formability of the material. Unlike mild steel, aluminum and other non-ferrous alloys do not have a yield point; that is, there is not a stress at which the metal deforms plastically without any increase in the stress. However, after a certain stress has been applied, the metal does cease to deform in direct proportion to the amount of stressing, and if the load is then removed the metal will be found to have taken a permanent set. Increasing the stress increases the amount of the permanent deformation.

For purposes of design, the unit stress which produces a permanent set of 0.2 per cent of the original dimensions is defined as the yield strength. If there is a considerable range between yield strength and tensile strength, the metal is usually easier to work than if this range is small. Then, too, if elongation is high, the metal is naturally easier to form.

Index to Formability

In choosing the proper temper to use, theses properties should all be considered. However, while they are an *index* to formability, the actual ability of the material to be readily worked should be based on its performance on the tools to be used in production. This is the true test which includes all factors.

Commercially pure aluminum, known as 2S*, is particularly noted for the ease with which it can be drawn, spun, stamped and otherwise formed. In fact, starting with a blank in the annealed temper, it may be taken through successive drawing and spinning operations with no need for intermediate annealing.

The alloys of aluminum are less ductile than the pure metal, and they offer a wide range of fabricating qualities in their various tempers. On one hand, an aluminum-manganese alloy (known as 3S) is only slightly less easily formed than pure aluminum. On the other hand, some alloys permit but a minimum of forming in their harder tempers. None of the alloys lends itself to as much forming as pure aluminum, and all of them require more liberal radii.

Two Groups of Alloys

The wrought alloys, from which sheet aluminum is rolled, are of two types. In one, comprising the so-called common alloys, the harder tempers are produced by strain hardening—that is, by cold working. In another type, known as heat-treatable alloys, the mechanical properties are increased by thermal treatments.

The common alloys, such as 2S, 3S, and 52S, cover a wide range of properties. Since these alloys strain-harden as they are formed, the greater amount of work can be done on them if the softer tempers are used as a starting point. Many drawing operations, however, can be done in the half-hard temper, and the less severe draws may be made in the full-hard temper. The temper is designated as "*O*" for annealed or dead-soft, "*H*" for full hard, and "¼*H*," "½*H*" and "¾*H*" for intermediate degree of hardness.

While the common aluminum alloys are suitable for a greater number of products, structures such as airplanes, bridge floor systems, dragline booms, and shovel dippers require the higher strengths of the heat-treatable alloys. Among these alloys are 17S and 24S, which are of the duralumin type, as well as 53S, 61S and others.

The fully heat-treated temper of these alloys is designated by the letter "*T*." An intermediate (as-quenched) temper of some alloys, including 53S and 61S, is known as "*W*."

Heat-Treated Alloys

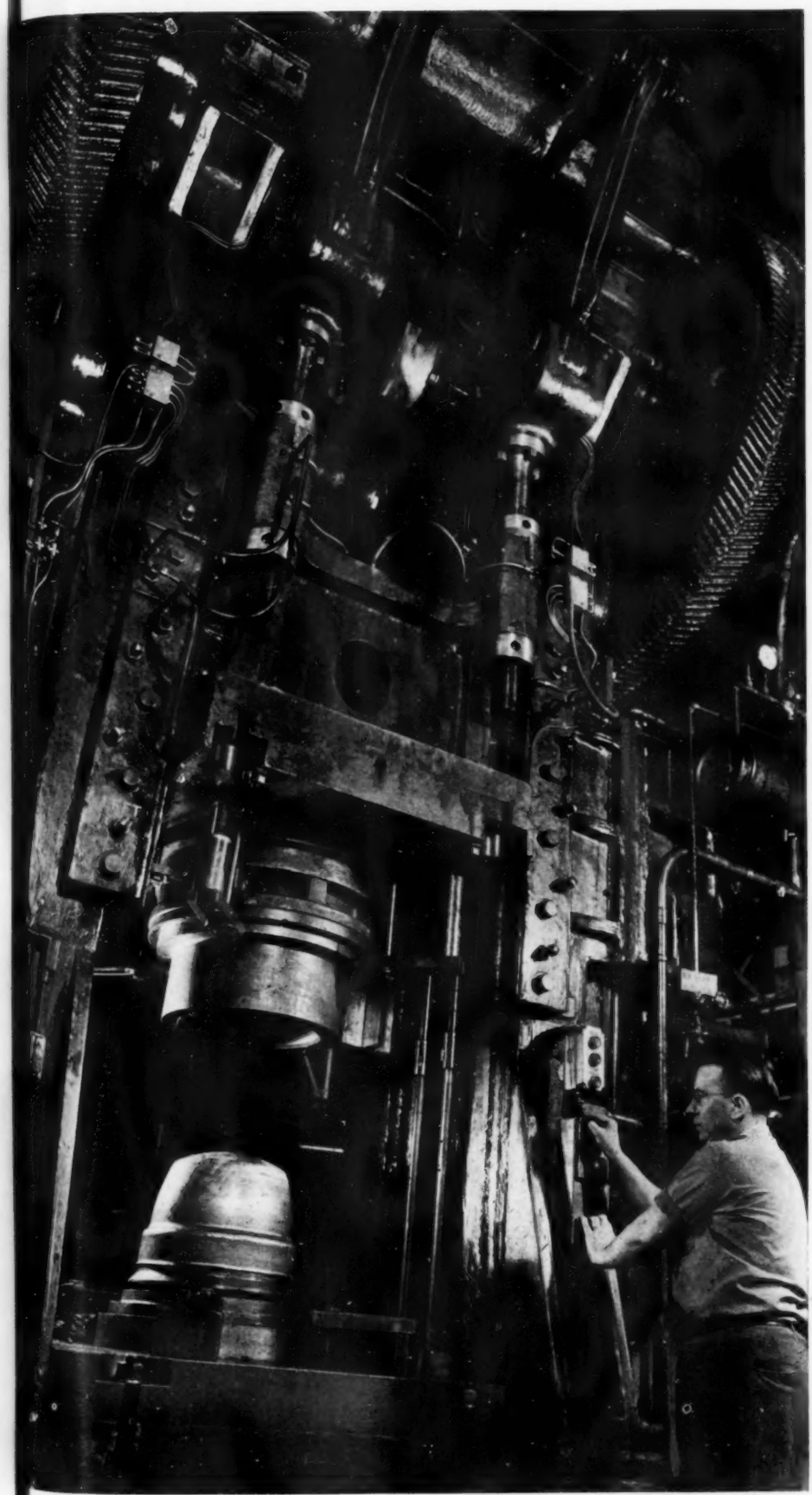
The most widely used heat-treated aluminum alloy is 17S. Both 17S and 24S, now the principal material used in airplane construction, lend themselves to a considerable amount of forming in the heat-treated temper. The more severe operations in these alloys have to be done in the annealed temper, and the part later heat-treated. However, the forming often may be done immediately after the metal has been quenched from the heat-treating temperature, so that the age-hardening takes place after the metal has

Table I—TYPICAL MECHANICAL PROPERTIES OF ALUMINUM ALLOY SHEET

Alloy and Temper	*Ultimate Strength (lb. per sq. in.)*	*Yield Strength* (lb. per sq. in.)*	*Elongation, per cent in 2 inches (1/16-in. specimen)*	*Brinell Hardness (500 kg., 10 mm. ball)*
2S–O	13,000	5,000	35	23
2S–¼H	15,000	13,000	12	28
2S–½H	17,000	14,000	9	32
2S–H	24,000	21,000	5	44
3S–O	16,000	6,000	30	28
3S–¼H	18,000	15,000	10	35
3S–½H	21,000	18,000	8	40
3S–H	29,000	25,000	4	55
52S–O	29,000	14,000	25	45
52S–¼H	34,000	26,000	12	62
52S–½H	37,000	29,000	10	67
52S–H	41,000	36,000	7	85
17S–O	26,000	10,000	20	45
17S–T	60,000	37,000	20	100
17S–RT†	65,000	47,000	13	110
24S–O	26,000	10,000	20	42
24S–T	68,000	44,000	19	105
24S–RT†	70,000	55,000	13	116
53S–O	16,000	7,000	25	26
53S–W	33,000	20,000	22	65
53S–T	39,000	33,000	14	80
61S–O	18,000	8,000	22	30
61S–W	35,000	21,000	22	65
61S–T	45,000	39,000	12	95

* Offset 0.2 per cent.
† Temper resulting from additional cold working after heat-treatment.

* These alloy designations are those applied to aluminum alloys produced by Aluminum Company of America under the Alcoa trademark.



This 450-ton double-action toggle press is set up to "cap" the top half of a 15½-gal. aluminum-alloy beer barrel

been formed to the desired shape rather than before. This practice makes it unnecessary to heat-treat the finished article, which may be difficult to handle. It also eliminates the need for correcting distortion, which usually occurs during heat-treating, particularly during quenching.

Alloy 53S is readily formed; and 61S has even better forming characteristics, even though its tensile and yield strengths exceed those of 53S. Alloy 61S can be bent around smaller radii than 53S and takes more severe deformation. Both these alloys age-harden after forming in the as-quenched temper, and thus develop higher strengths. There is no appreciable distortion or change in dimensions during this aging treatment.

A review of Table I will show that a wide range of tempers in commercially pure aluminum and in the aluminum alloys is available for mild forming operations. For the more severe operations, however, the choice may have to be limited to the dead-soft temper.

Selection of an alloy depends upon other factors, of course, than just its formability. Some products are exposed to marine atmospheres and will have to be made from an alloy such as 52S and 53S. Others, such as containers for transporting chemicals, must not only resist the corrosive influences of the chemical, but must have adequate strength to withstand handling. In such a case, the choice of alloy is limited both by mechanical and chemical considerations. The choice of temper is then made so that, after fabrication, the finally shaped product will have the necessary strength.

Table II—NOMINAL COMPOSITION OF ALUMINUM ALLOYS

Alloy	Alloying elements, per cent*				
	Cu	Si	Mn	Mg	Cr
2S					
3S			1.2		
52S				2.5	0.25
17S	4.0		0.5	0.5	
24S	4.4		0.5	1.5	
53S		0.7		1.3	0.25
61S	0.25	0.55		0.95	0.25

* Aluminum and normal impurities constitute remainder.

The second article in this series on the cold working of sheet aluminum will appear in an early issue.

Tips for the cutter grinder

BY A. H. PREY, THE CARBORUNDUM COMPANY

It costs less to keep cutters and reamers sharp than to let them become excessively dull before resharpening. Dull cutters lead to high shop costs

DULL CUTTERS break easily. With proper care they will give long service. Even if a dull cutter can be reconditioned, an excessive amount of material must be removed at each grinding. Only a slight amount of material need be removed if the cutter is reground frequently.

Some milling cutters and reamers are sharpened on the periphery by grinding the clearance angle behind the cutting edge. They include such tools as straight and helical tooth milling cutters, side milling cutters, face mills and end mills. Formed cutters and hobs are ground in an entirely different manner—on the radius.

Clearance angles may be ground with either straight or cup wheels. Two methods are possible with either type of wheel. With one, the wheel passes from the body of the tooth and off the cutting edge. This method has the advantage that the action of the wheel holds the tooth firmly against the rest under the tooth being ground, and so prevents the cutter from rotating. It has the disadvantage of raising a burr on the cutting edge which later must be removed by stoning. This method also may draw the temper of the tool.

If the grinding is done toward the body of the cutter, there is less danger of burning the tooth and no burr is formed. However, the tooth rest must be placed above the tooth, and the action of the grinding wheel tends to move the tooth away from the rest. Unless the tooth is held firmly against the rest by the operator, there is danger of jamming the tooth against the wheel.

Maintenance of the correct clearance angle is of utmost importance. Too much clearance makes the cutting edge too thin, and the teeth will wear rapidly. If the clearance angle is insufficient the teeth will drag and cut too slowly, and the cutter will become dull quickly.

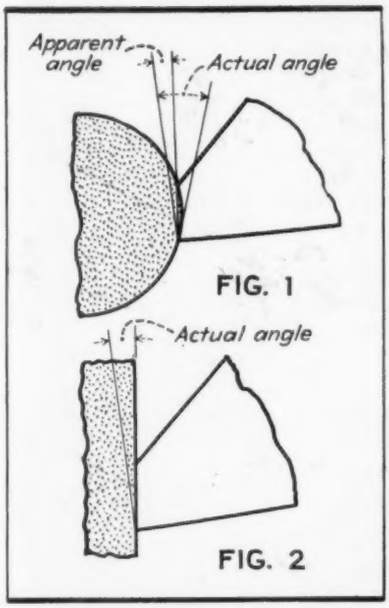


Fig. 1—When grinding clearance angles with a plain wheel, apparent angle is less than the actual clearance angle at the cutting edge. Fig. 2—This discrepancy does not occur when using a cup wheel

Since a plain grinding wheel grinds hollow, the actual clearance angle is somewhat larger than the apparent angle, as shown in Fig. 1. With a cup wheel, Fig. 2, this discrepancy does not occur. By tilting a plain grinding wheel the surface will not be so "hollow", and the cut will approach a straight line. By this method cutters with narrow lands, and those up to 4 in. in diameter, may be ground satisfactorily with a straight wheel. Large cutters should be ground only with cup wheels. Care should be used when sharpening cutters with cup wheels, since the greater area of contact between the wheel and the tooth tends to heat the work unduly.

The desired clearance angle is secured by adjusting the relative positions of the wheel, the cutter and the tooth rest. If the machine is equipped with dials on the workhead which are graduated in degrees, the setting of the cutter to secure the correct clearance angle is simple. Other machines simplify the setting by using a system of gears in the workhead which produce the correct angle and automatically index each tooth as the grinding is done.

Lacking these devices, the setting of the tooth rest may be determined by tables or by a simple calculation. When using a plain wheel, the distance to raise or lower the cutter and tooth rest is given by the formula: clearance angle in degrees $\times$ wheel diameter in inches $\times$ 0.0088. With a cup wheel, the distance equals the clearance angle in degrees $\times$ cutter diameter in inches $\times$ 0.0088.

When using a cup wheel, with the tooth rest mounted on the wheelhead, the wheelhead is raised or lowered with no adjustment of the tooth rest. If the tooth rest is mounted on the table, the wheelhead is raised or lowered to avoid grinding on the tooth next to the one being sharpened and the tooth rest raised or lowered.

With a plain wheel, whether the tooth rest is mounted on the wheelhead or the table, the wheelhead is raised or lowered, and the tooth rest brought in line with the center of the cutter. Of course, the same effect is achieved by raising or lowering the table in the opposite direction to that indicated above for the wheelhead.

Whether the tooth rest is fastened to the table or wheelhead is governed by the following considerations: it is fastened to the table when grinding tapered cutters and reamers with straight teeth in order to produce the same clearance angle for the full length of the tooth. In sharpening spiral milling cutters on centers, the rest must be fastened to the wheelhead, unless the cutter is free to revolve and move lengthwise on the arbor. In this case the tooth rest may be mounted on the table.

If mounted on the wheelhead, the rest must be set so that the cutter will pass off the wheel before it passes off the tooth rest. In grinding helical mills, the tooth rest must be set to follow the angle of the helix.

With the set-up correct for the

desired clearance angle, the cutter is brought barely into contact with the wheel and passed back and forth. The tooth then is inspected to make certain that the machine is set to follow the old clearance. To make sure that the teeth will not be ground on a taper, grind two adjacent teeth, rotate the cutter 180 deg., grind the two opposite teeth, and measure the diameter of the cutter on the newly ground teeth.

To make sure that the temper of the cutter will not be drawn, be careful not to use too hard a wheel or too high a wheel speed. With a straight wheel, take not more than 0.002 in. cuts—and even less when using a cup wheel. Obviously, if some teeth are higher than others, the high ones will do all the cutting. Therefore, care must be taken to take exactly the same amount from each tooth. Wheel wear may make the last tooth too high. To offset this effect, each tooth should be ground twice, starting at 180 deg. from the first tooth ground when going around the second time.

The hole in the cutter must be round and the mandrel or arbor straight and round. The tooth rest should have a flat top, with rounded corners, and it should be somewhat wider than the wheel so that the cutter can move past the wheel when the next tooth is being indexed.

Continued grinding of the clearance angle will, in time, make the land too wide. To correct this, sharpen by grinding in the usual way to the desired clearance angle, and then grind a secondary clearance to bring the land to the correct width.

A helical milling cutter should be mounted on a cutter bar which is supported by the footstock. Traverse may be obtained by moving the table or by sliding the cutter on the bar. With table traverse, the tooth rest should be mounted on the wheel head. If the cutter is moved the rest may be on the table, but it is essential that it be in line with the wheel face. Stops should be provided to prevent the cutter from running off the rest. A plain wheel, or a straight or flaring cup wheel may be used.

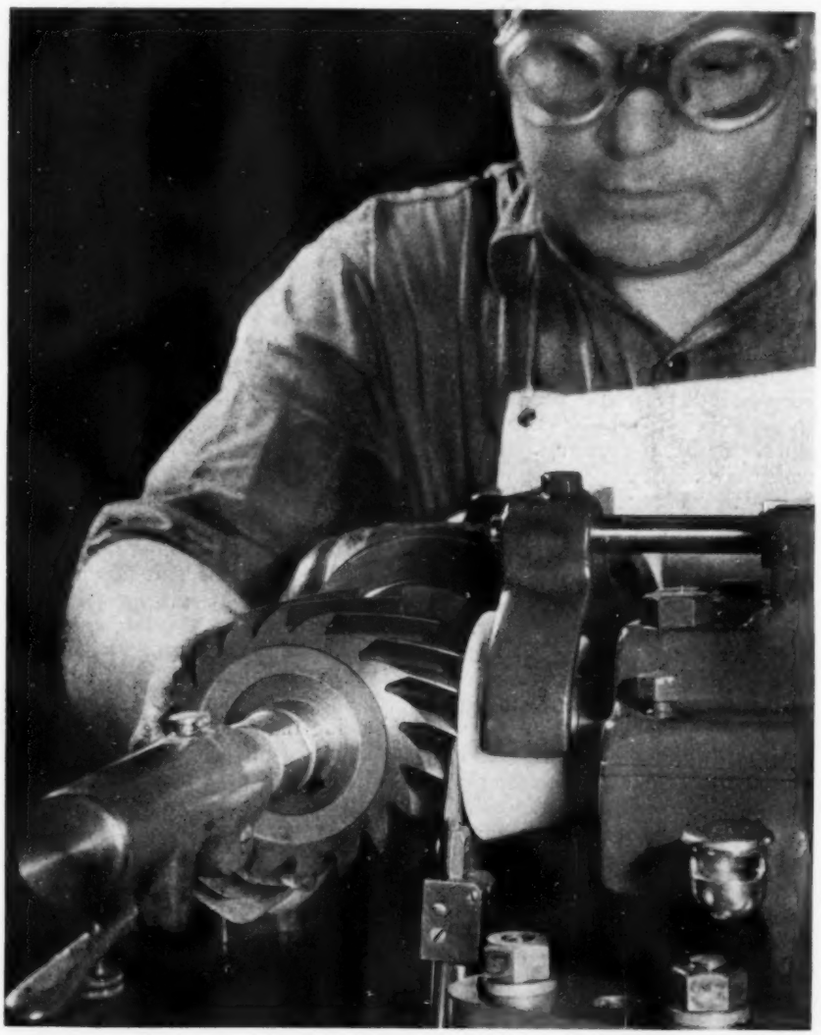
Care must be taken when sharpening a side milling cutter to keep the land and the clearance angle, as well as the secondary clearance angle to the maker's specifications. The cutter is held on a stud mounted in the workhead spindle, which is swivelled for clearance. Either straight-cup or flaring-cup wheels may be used. If a plain wheel is used, the cutter arbor should be horizontal and the wheelhead raised or lowered to secure the clearance.

End mills with shanks should not be located on centers, for if the mill is sprung it will be sharpened out of proper relation to the shank. The shank should be held in the taper of the workhead spindle, which will duplicate the working position of the cutter. The tooth rest should be fastened to the table and the workhead swivelled to secure tooth clearance.

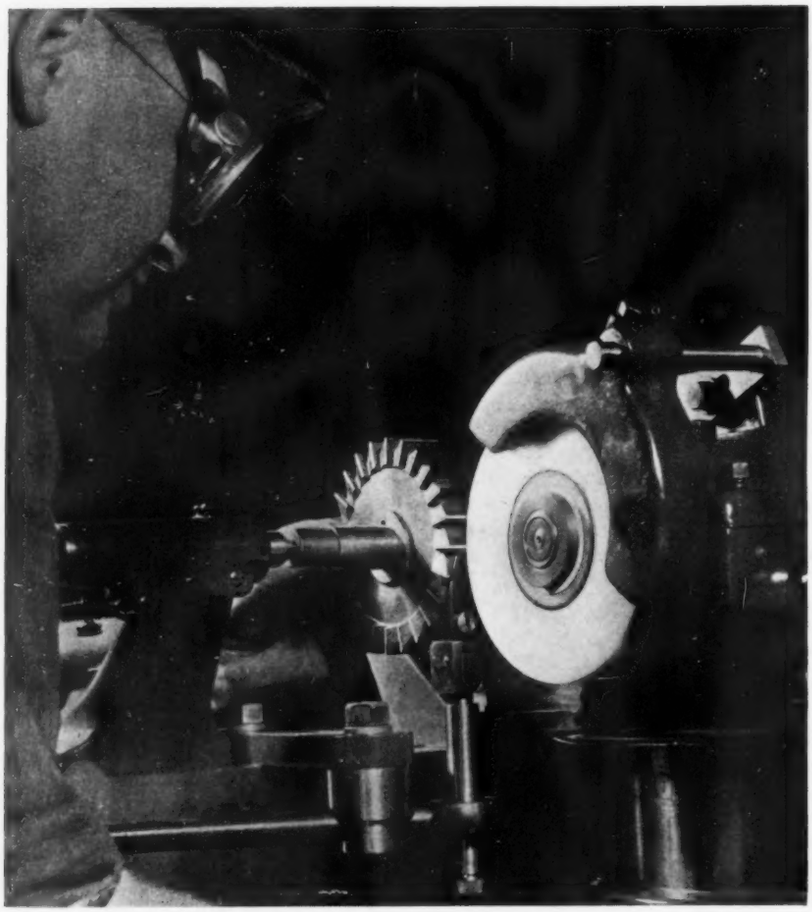
Large face mills should be mounted in a specially designed grinding attachment. On these mills it is necessary to grind the face, the periphery and the corners of the teeth. The corners may be rounded with a radial grinding fixture or, if a true radius is not required, a 45 deg. flat may be ground with a 22½ deg. angle at each side of the flat.

To grind the corners of a shell end mill, the cutter is mounted on an arbor supported by the workhead, which is swivelled to 45 deg. It is best to mount the tooth rest on the workhead, since the work holder then can be adjusted without disturbing the rest. Be careful to keep the face of the tooth against the rest.

A helical cutter is mounted on an arbor between centers for grinding. The wheel is rounded to a radius of about $\frac{1}{16}$ in. and tapered back to the thickness of the wheel. The tooth rest is given a slight radius and set so that only its center will be in contact with the cutter at a point on the vertical centerline of the wheel. The cutter, wheel and rest should be in contact at a common point. Allowance must be made in the tooth rest setting for the helix angle in order to get the correct clearance angle. As the helix angle increases, the clearance angle is reduced. If desired, the wheel face may be left square and



The desired clearance angle is secured by adjusting the relative position of the wheel, the cutter and the tooth rest. Cuts with a cup wheel should be light to prevent overheating the cutting edge



When a plain wheel is used, the wheelhead is raised or lowered to secure the proper clearance

the wheelhead tilted slightly. A plain wheel is used.

To grind the side teeth of an angular cutter, the cutter is held on the end of the work spindle which is swivelled to the angle of the cutter. The tooth rest is mounted on the workhead and the table is traversed. Either straight-cup or flaring-cup wheels are used. The same method of mounting is used for grinding the end teeth. To grind the teeth a trifle low at the center, the workhead is swivelled 1 or 2 deg. The tooth rest is fastened to the table, and the work traversed across the wheel.

Reamers must be sharpened more accurately than milling cutters. The land must be narrow and of the same width at all points. Two operations are required. The proper clearance angle first is ground as for a milling cutter. The heel of the blade then is ground off to bring the land to the correct width.

A hand reamer for steel must have a land of only 0.006 to 0.008 in. width. The clearance, therefore, may be ground cylindrically. The wheel must strike the heel of the blade first, otherwise there would be no clearance. When the blade strikes the wheel the reamer springs slightly, which gives all the clearance needed. Secondary clearance then is ground in the usual way.

It is necessary to grind separately each tooth of a hand reamer for cast iron or bronze, since the clearance is too great to be ground cylindrically. The procedure is the same as for a milling cutter. A secondary clearance to give a land of from 0.020 to 0.025 in. then is ground.

In sharpening a roughing chucking reamer for steel the secondary clearance is ground first and the cutting clearance then is ground cylindrically. Next, the blade relief is ground about 0.020 in. smaller than the hole diameter. About $\frac{1}{2}$ in. is allowed for the length of the cutting blade. Last, the corners are ground, using the same wheelhead setting as for the secondary clearance.

Cutting clearance of a finishing chucking reamer for steel is ground cylindrically. The clearance is produced by the spring of the reamer caused by the wheel coming in contact with the heel of the blade before it strikes the cutting edge. A secondary clearance to provide a land of about 0.006 to 0.008 in. then is ground.

Considerable care must be used in sharpening a taper reamer. The land should not be more than $\frac{1}{32}$ in. After sharpening, gage the reamer with a collet. If it seems correct, take a trial cut and test the hole with a gage before using the reamer. The cutting edges must be straight. If honing is not sufficient to straighten them, grind them with a plain or cup wheel.

Some formed cutters are so made that the form of the tooth is on the radius of the cutter. It is important that all sharpening be done by grinding on the face, being careful to keep to the radius. If the face of the tooth is ground at an angle to the radius the shape of the tooth will be changed.

Other formed cutters are off-set; that is, the face of the tooth is at an angle to the radius. This angle must be preserved, or the shape of the tooth will be changed.

Formed cutters are ground either on a cutter grinder or on a surface grinder equipped with proper fixtures. The tooth rest is in contact with the back of the tooth which is being ground. The wheel face must be trued carefully with a diamond. A dish type wheel is used. Feeds should be light. The wheel must be located carefully with respect to the work. Wheel face must be in line with the center of the cutter, except for offset cutters.

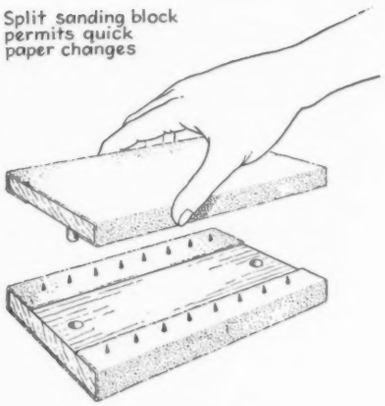
A narrow formed cutter can be fastened to the tool holder mounted on the table and fed by hand. Use a dish type wheel. This method requires skill on the part of the operator, but is rapid. For greater accuracy, use a gear cutter grinding attachment.

A wide formed cutter is mounted on a gang arbor and traversed by moving the table. To insure correct spacing of the teeth, grind the backs of the teeth of a new cutter before grinding the face. The cutter may be rotated very slightly, and the face kept radial, by tapping lightly on the tooth rest holder. Use a dish type wheel. Straight tooth hobs are ground the same as formed cutters.

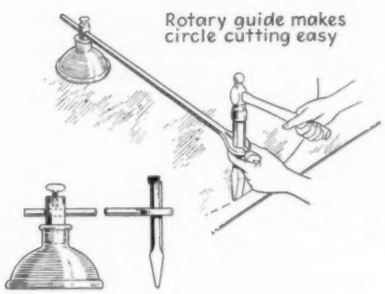
Helical tooth hobs may be ground by various means, using special attachments. A common method is to use a master form which is milled with the same helix as the hob. The tooth rest revolves the hob according to the master form which it engages.

SHORT CUTS FOR THE SMALL SHOP

By A. H. WAYCHOFF

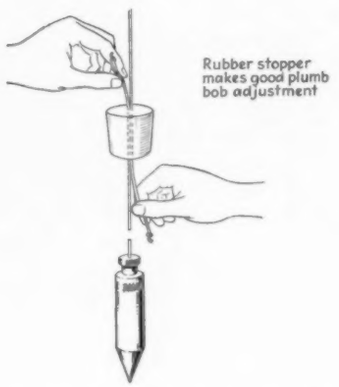


THIS SANDPAPER BLOCK is about tops in simplicity and adaptability. In one piece is set a pair of short dowels, while in the other are drilled holes to match. The dowels should fit a little tight. A few brads driven through each block along the sides, so the points come through about a quarter of an inch, hold the paper. You can use coarse on one piece and fine on the other. The brads bedding into the opposite blocks hold the paper perfectly, and the tight dowels keep the whole works together.

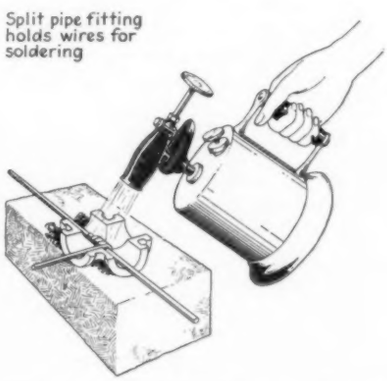


PERFECT CIRCLES can be cut in heavy sheet metal with this handy little device. An ordinary plumber's vacuum cup has an iron plug poked in the handle hole. In this plug is a three-eighths-inch cross hole and a vertical hole drilled and tapped for a wing screw. The rod sliding in the cross hole is split at one end to form a small chisel holder. In use the rubber socket is well soaped so the plug can turn easily, and the rod adjusted for the desired radius. Then by hitting the chisel with a hammer as it's moved around the circle, a perfect disk with smooth edges is cut. For any shop making disks out of metal too heavy to be cut with tin snips, this method is a lot quicker and better than laying out a circle and trying to follow it with a cold chisel.

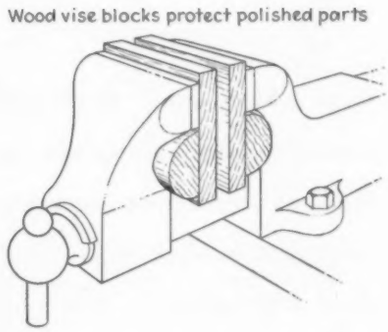
NO TIME IS WASTED making an elaborate screw holder for a screw driver if you use just an ordinary pencil clip. All that has to be done to it is to bend a little kink near the end to catch the screw head. Then push it on the shank and squeeze the body together to make a tight sliding fit. That way it'll hold both screws and small bolts for starting in the most inaccessible places.



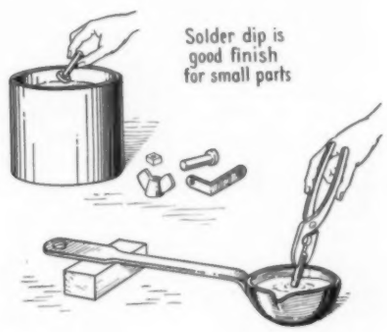
A GOOD WAY to adjust a plumb bob line is to use an ordinary rubber stopper as shown. Punch a couple of holes through it with an ice pick, then run the strings through the holes and knot each end. Adjustment is easy and accurate.



WIRE CONNECTIONS and rod and tube work where right-angle takeoffs are to be soldered can be handled a lot easier with this jig made from a pipe fitting. For average wire or rod work a one-eighth inch fitting is about right. All that is necessary is to split a common "cross" with a hacksaw and use as shown.



WHERE WOOD OBJECTS or polished metal sheets must be held in a vise, these easily made wooden blocks will be found a real convenience. Cut a couple of hardwood blocks a little wider than the vise jaws and long enough to project a little above the jaws when their ends rest on the vise screw or box. Then make a cleat for each block to fit the vise throat, to give parallel seating. The blocks can be held in place with strips cut from an old inner tube stretched around the jaws, if it's desired to use them most of the time.



BRIGHT FINISHING little parts for models or small mechanisms can be done easily just by tinning them. Clean the parts in hot lye water, rinse, and dry. Then dip them in as strong a solution of sal ammoniac as water will make. Let the parts stand till thoroughly dry. Melt up some pure tin, a few old collapsible tubes or some ordinary solder, and with the metal real hot dip the sal-ammoniac-covered parts in it. They can be dipped for about half their length, then turned end for end and the other half dipped. The lap won't show. This coating is bright, adheres perfectly, and is a lot less trouble to apply than rigging up for nickel plating. The parts will stay shiny for a long time, and a coat of clear lacquer will make the finish last for years.

Heavy sections welded well

BY E. JAMES, WELDING ENGINEER, PACKARD MOTOR CAR COMPANY

Good butt and projection welds on steel stampings to forgings depend on accurate control of welding current and time, plus adequate clamping

TYPICAL of the progress made in application of resistance welding to assembly of heavy sections are two operations on the 1941 Packard front-wheel torque arm. In the first operation a forged screw plate is flash-butt welded to one end of the 0.157-in. thick torque arm. In the second a steel bushing with a $\frac{9}{32}$-in. thick wall is projection welded concentric with the hole in the opposite end of the stamping. A production research program under the guidance of J. E. Doyle, general master mechanic, made practicable these operations.

Uniform Thickness Essential

The torque arm assembly measures 24.570 in. from the finished face of the screw plate to the center line of the bushing hole. The latter must be reamed $1\frac{3}{8}$ in. $\pm$ 0.005 in., and the wall thickness must be uniform. Consequently, in the first operation, the piece is located from the bushing hole. The forging end face must not exceed $\frac{1}{32}$ in. over final dimension, to permit cleaning up by grinding. When projection welding the bushing, the torque arm is located from the forging end face. If the axis of the bushing is tipped one minute of arc, the wall thickness after reaming may vary as much as $\frac{1}{32}$ in. on one side, because of error magnification by length and angular relationships of the components. These considerations call for accurately controlled welding cycles, heavy fixtures and well-guided machine slides. To meet these requirements, special press welders of heavy arc-welded construction have been built to Packard specifications.

Flash-butt welding the screw plate to the torque arm is done at the rate of 300 assemblies per hour. The stamping is placed flange side up in the stationary part of the fixture. Two pushbuttons, pressed by the operator, energize a holding circuit in the weld timer, to start the welding cycle.

Several actions now occur automatically. The holding circuit energizes a solenoid valve controlling two 5-in. direct-acting cyclinders operating vertical clamping slides. These slides move down into contact with the stamping and the forging respectively, until a force of 16,000 lb. is applied to the two parts. When this is reached a pressure switch is tripped, energizing a second solenoid valve. This valve brings into play four 3-in. cylinders which apply side clamping pressure. Two opposed cylinders are used on the stationary half of the fixture, two more on the movable section. When correct pressure is built up in these cylinders, another switch is stripped, which in turn operates a limit switch to start the table in motion. In addition, a relay is tripped to energize the welding contactor and the Ignitron heat control panel.

Burn-off and upset are obtained by a cam-operated table which moves the forging into contact with the stamping. Total movement is $\frac{9}{16}$ in., a burn-off of $\frac{9}{32}$ in. being allowed on each piece. An upsetting pressure of 9,000 lb. is reached on this particular job. A variable-speed drive to the table cam permits changing burn-off time. At the end of the upset, the table and all clamping cylinders automatically return to loading position.

Electrical Demands Heavy

The hydraulic system includes a combination pump which delivers oil at 300 lb. pressure to the small horizontal clamping cylinders and at 600 lb. to the larger vertical cylinders. This pump is capable of delivering 13.7 gal. per min. and is driven by a 5-hp. 440-volt three-phase motor.

The machine draws 1020 primary amperes, delivered on a bus consisting of four pieces of $\frac{1}{4}$x6 in. copper. This bus is also used for the projection welder. Electrical controls consist of a welding contactor, an Ignitron-tube heat control panel and a 225-amp. two-pole circuit breaker. A 250-kva. water-cooled transformer with an eight-step secondary for heat control is located within the welder base.

Successful projection welding of the bushing to the torque arm required solution of a number of problems before the desired metallurgical properties were secured in the bond. Not the least of these problems was the projection shape. First tried was the common rule-of-thumb: a projection height equal to two-thirds of the metal thickness, equal included angles of the sides, and a flat, or land, about $\frac{1}{16}$ in. wide. This projection produced a bond that did not fail in a destruction test, but a microphotograph revealed a definite separation between the crystalline structures of the two parts.

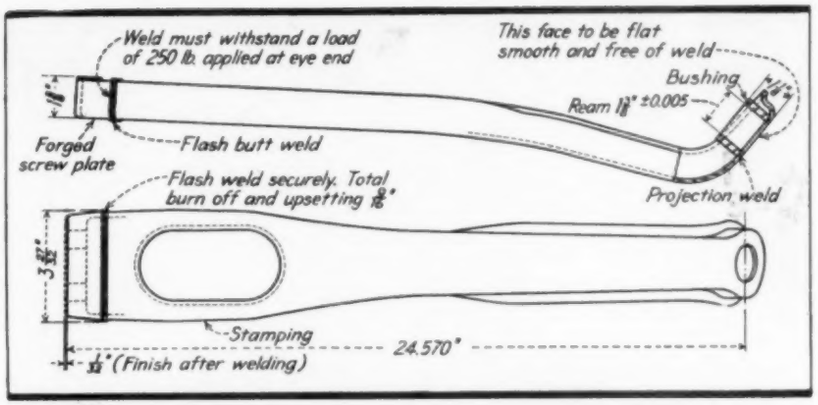
Shape Found by Experiment

Next, experiments with projection shape were instituted. Each time new values for current, time and pressure had to be established. Even the bushing material was changed. A microphotograph was made of each test weld. Use of microphotographs in production research on welding problems materially shortens the cut-and-try process and gives direction to the work.

Finally, a proper bond was secured by the projection shape illustrated. Unequal angles of the projection cause the metal to flow into a smooth-radiused joint with the stamping, and without flash at the plane marked. It will be seen from the microphotograph that the crystalline structures of the two metals are well intermingled, or "married." This is a "perfect" weld, as far as it is possible to make. There is no question of weld failure in service.

A problem in welding-fixture design presented itself because of the shape of the torque arm and the necessity for keeping the bushing exactly at right angles with the angular face of the stamping while upsetting the weld. For this reason, the bushing is placed over a hard bronze plug in the stationary electrode on the press welder knee. The torque arm is clamped in a fixture which is connected to and moved down with the slide. In placing the torque arm in

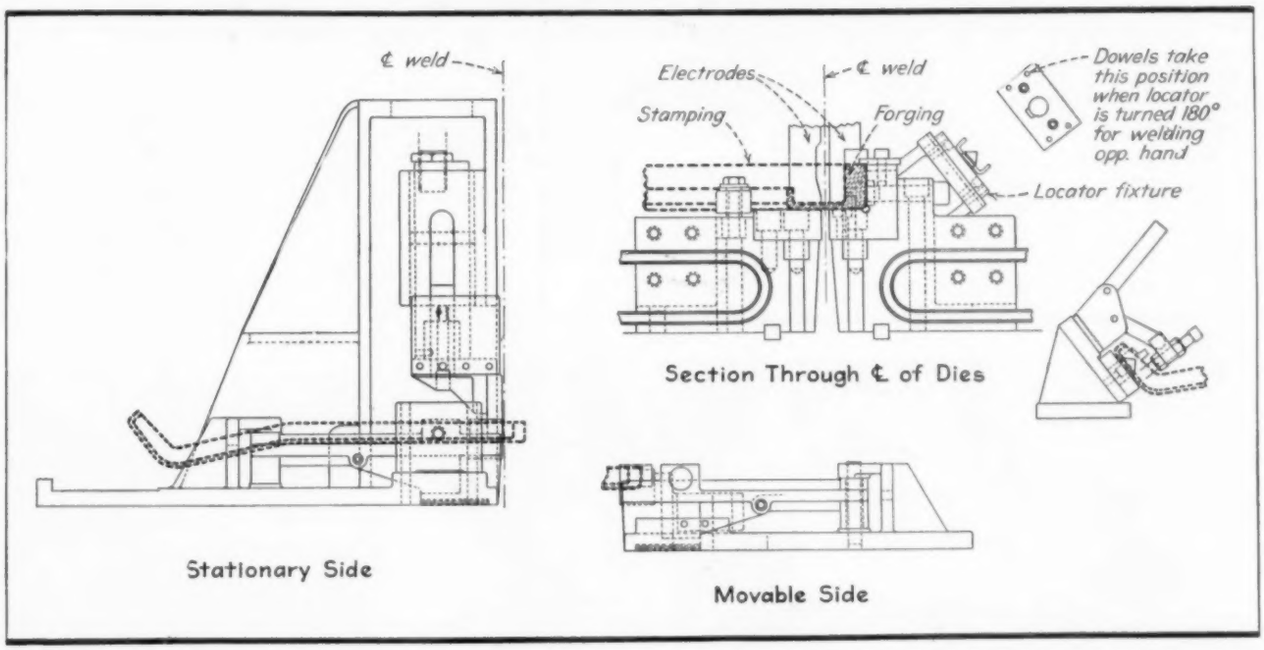
Resistance welding makes possible a torque-arm assembly like this. Savings are worth the effort expended on an extensive production research program


Weld must withstand a load of 250 lb. applied at eye end
This face to be flat smooth and free of weld
Bushing
Ream 1⅛" ±0.005
Forged screw plate
Flash butt weld
Flash weld securely. Total burn off and upsetting ⅛"
Projection weld
3⅝"
Stamping
24.570"
½" (Finish after welding)

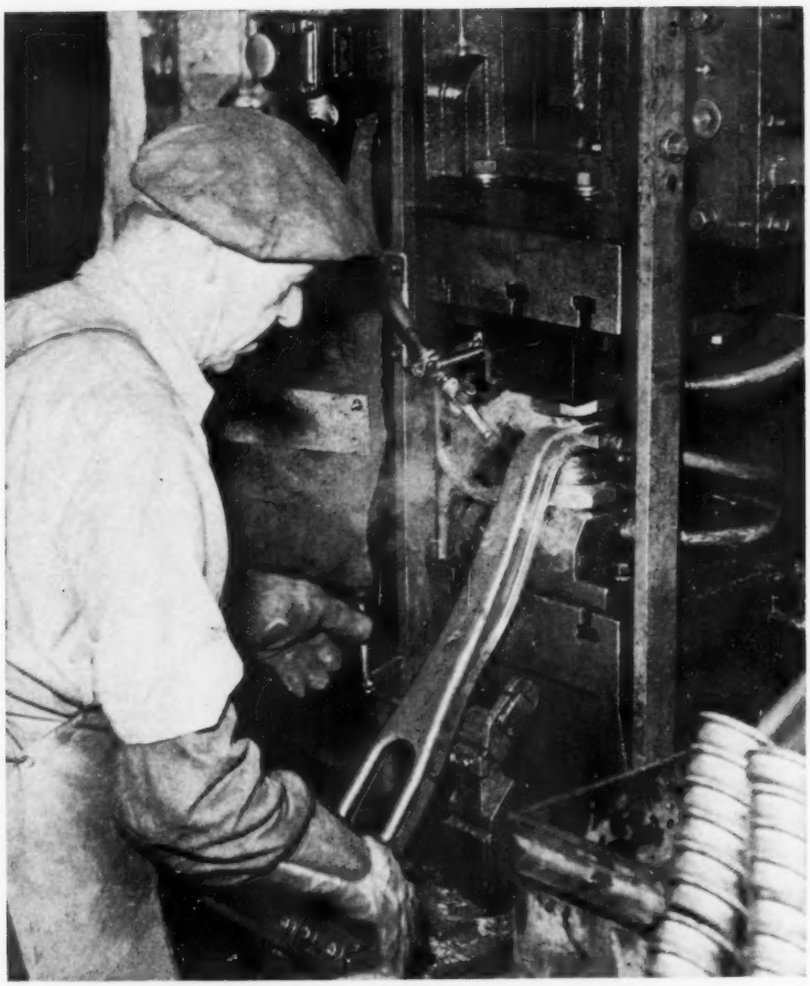
the fixture, the circular end is located in a nest fixed to the ram, while the center and the opposite end are located and held by two hand-operated cam clamps. Rectangular guide bars connecting the fixture to the slide are made of brass to avoid a disturbing magnetic field near the electrodes. A limit switch on the slide prevents welding if a bushing has not been inserted properly in the stationary fixture.

The projection welding process is entirely automatic after the operator presses a button. This action energizes a holding circuit in the special weld timer. The holding circuit in turn energizes a solenoid-controlled valve which admits oil at low pressure to the cylinder to feed down the V-guided clamping slide. When a predetermined pressure is built up in the cylinder a pressure switch is tripped, which starts a special weld

Flash-butt welding the screw-plate forging to the torque-arm stamping involves moving and stationary fixtures. Vertical and hydraulic cylinders conveniently apply clamping pressures to both fixtures. Upsetting slide is cam-driven



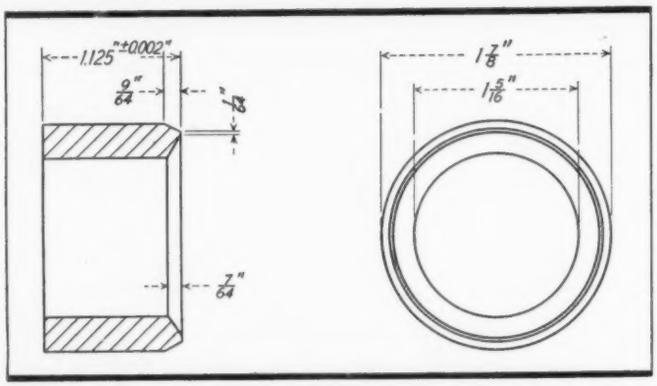
Heavy, accurately built fixtures align the forging and torque arm stamping for flash-butt welding. Upsetting is controlled to attain minimum flash



timer controlling an electronic-tube contactor. Current is applied to the weld for six cycles, at which point the low-pressure circuit in the timer drops out. The high-pressure solenoid valve is immediately tripped to build up an upsetting pressure of 28,000 lb. There is actually no interruption in welding current between low- and high-pressure welding. Current is instantaneously resumed when the high-pressure circuit is energized and it is continued for eight more cycles. When upsetting is completed, a relay is tripped, releasing the high clamping pressure, returning the machine to the loading position and resetting all of the controls for the next cycle.

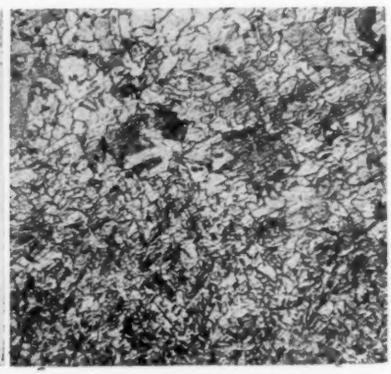
The projection welder incorporates features to permit its use on other jobs by merely changing fixtures and resetting controls. Shut height adjustment amounts to 3 in., and knee adjustment of 8 in. is secured through two leadscrews. A wide range of heat control is provided by the Class A (Resistance Welder Manufacturers Association standard) transformer,

Before oil smoke can clear away, the operator swings aside the welding curtain and removes a completely welded torque arm from the special press - type projection welder developed at Packard



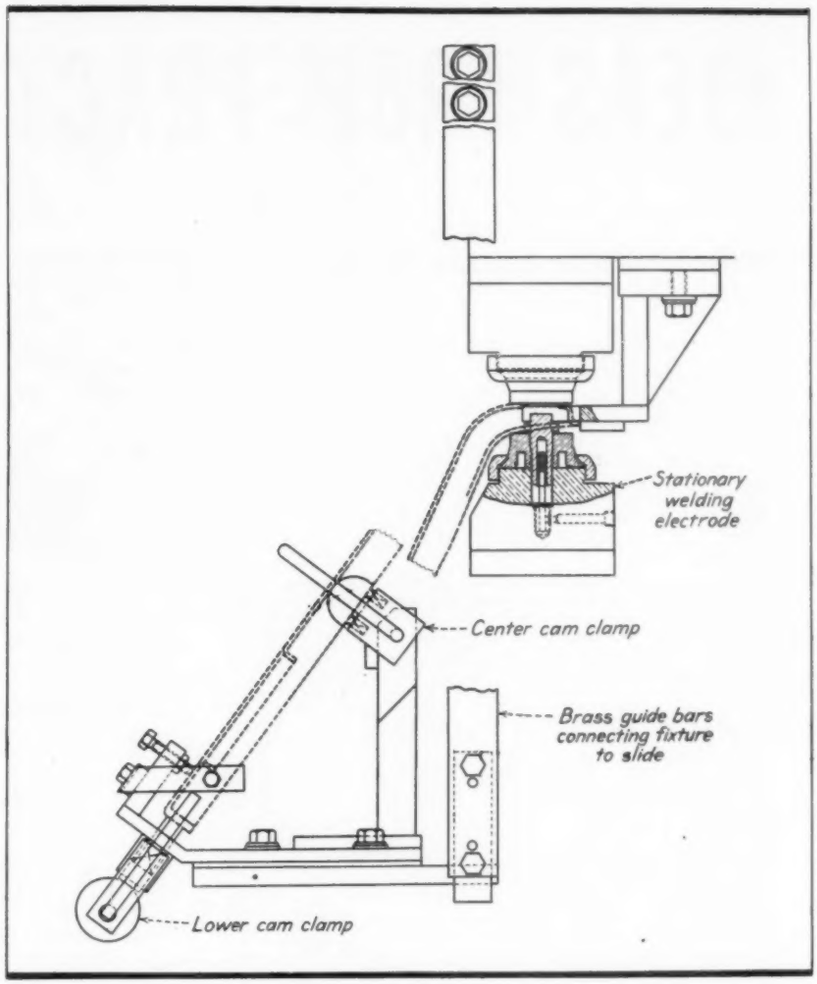
Correct shape of the bushing projection was obtained by experiment

Cut-away sections of the bushing and stamping show that correct projection shape promotes a smoothly radiused upset without flash at the bushing hole. A photomicrograph at section A-A reveals metallurgical properties of the weld. Magnification is 200 times. Bushing metal is above, stamping structure is shown below



mounted in the machine base. This transformer has sixteen steps of heat regulation, is rated at 700 kva. 60 cycles, and operates on 440 primary volts. Electrical controls consist of an electronic welding contactor, a special timer, and a 600-amp. circuit breaker. The machine draws 4,800 primary amp., delivered on four pieces of ¼x6 in. copper bar from a bank of two 500-kva. power transformers which are installed outside the building.

The hydraulic system includes a combination pump driven by a 5-hp. 440-volt motor. The pump delivers 13 gal. per min. for low-pressure clamping of the head, and 1.6 gal. per min. for the higher upsetting pressure. Maximum pressure attained by the pump is 1,000 lb. per sq. in. An unloading valve and a pressure-regulating valve unit are included in the hydraulic equipment. Stable oil temperature is attained by equipping the machine with a 30-gal. sump complete with water cooling tubes.



To compensate for upsetting the bushing projection, the fixture containing the torque arm must move down with the welding-machine slide by the amount of upsetting

Metal That Burns

PRECAUTIONARY MEASURES against magnesium fires are hard to enforce because the mind rebels at the idea of a metal burning, and these fires are difficult to extinguish because the most natural thing to throw on a fire—water—is virtually the worst imaginable for magnesium.

The fact remains that magnesium alloys do burn very intensely in powder, ribbon, chip or dust form. Heavier pieces are not particularly combustible as they rapidly conduct away the heat; however, when an entire piece can be brought up to about 1,000 F., ignition will take place.

Oxygen for combustion of magnesium is supplied more rapidly by water than by air. Thus wet magnesium burns more intensely than does the dry metal, and once ignited it will continue to burn under water. For this reason, all common water-type extinguishers are worthless on magnesium fires. Carbon tetrachloride on hot magnesium gives off chlorine. Carbon dioxide, foam and dry chemical extinguishing agents give off oxygen. Both chlorine and oxygen combine with the burning metal to intensify the fire.

Where magnesium chips are already covered with cutting oil, combustion is not so rapid, since the air necessary for combustion is cut off by the oil film. Using oils to extinguish fires, however, is not advisable because it is difficult to apply without igniting the oil itself.

Fires in small quantities of scrap are best extinguished by powdered talc, cast-iron borings, or similar inert material. When the magnesium has considerable bulk, there is no practical way of extinguishing the fire. Effective prevention is the only reliable insurance against a serious blaze.

In machining magnesium, no water, even in mulsifiable cutting oils, should be used. If dry machining is not practical, a mixture of kerosene and lard oil or straight kerosene is preferable. Turnings should be constantly swept up, so that if ignition occurs at the cutting tool, as it may from friction, the fire will not spread.

Magnesium dust in air is highly explosive. Because of this, ordinary types of dust collectors should not be used to remove dust from grinding. A special collecting system is needed, which utilizes a water spray to wash the dust into a trough where it will be carried away as sludge. This should be collected in drums, mixed with four or five parts of sand and disposed of on a dump. In this condition it may still burn but with little intensity. In actual grinding of magnesium alloys, only grinding wheels reserved expressly for this purpose should be used. If the wheels are used for ferrous metals also, particles may adhere which might produce disastrous sparks.

From a report of Factory Mutual laboratories fire tests on magnesium alloys, conducted under the direction of the Inspection Department of Associated Factory Mutual Fire Insurance Companies.

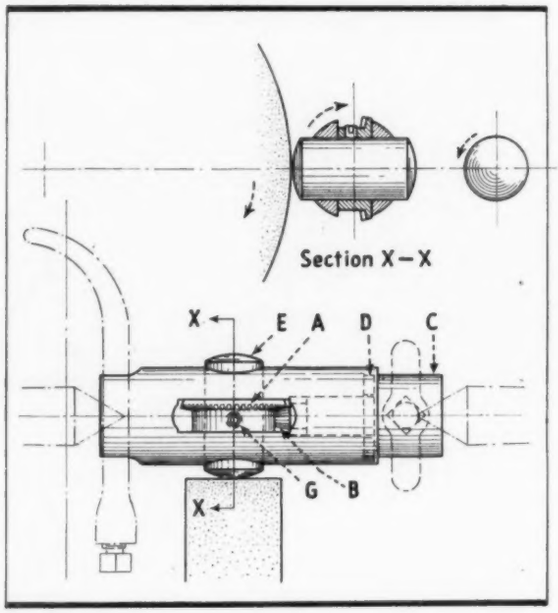
IDEAS FROM PRACTICAL MEN

Fixture for Grinding True Radii on Pins

By PETER VEIT

The illustrated fixture was designed to grind the ends of pins spherical with a true radius, regardless of the length of the pin. The master ring gear *A* is cut with 75 teeth, while the pinion gear *B* has 19 teeth. The pinion gear shaft *C* should be clamped so that it does not revolve; this is extremely important. The pinion shaft *C* is fitted with thrust bearing *D*.

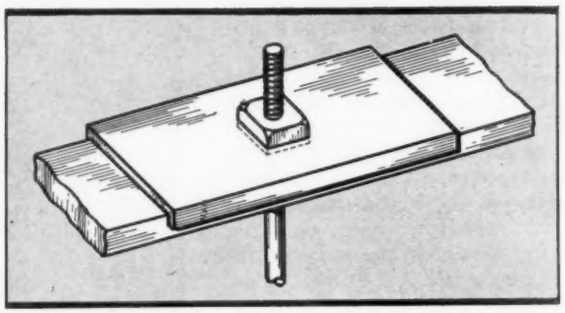
The pin to be ground is inserted in the fixture



This fixture will grind spherical surfaces with true radii on pin ends regardless of its length

through the ring gear *A*, and the set screw *G* in the ring gear is tightened. The pin is centered for length. The fixture is driven by a dog or forked driver on the headstock end. Direction of rotation of the pin, fixture and grinding wheel are shown by arrows in Section X-X. As the fixture rotates on the spindle and headstock center, turning the pin end for end and bringing the ends into contact with the grinding wheel, the pin rotates in the fixture. The combined action of such rotation results in grinding the ends spherical.

The gear ratio used is such that it takes 75 revolutions for the pin to pass the wheel at the same spot. Should an 80:20 ratio be used, the pin would grind from four sides and there would be two radii, but they would not be spherical. The design or shape of the fixture can be changed to suit various requirements, such as for grinding pin gages or floating wrist pins.



This device not only provides means for locking the nut, but also serves as a wrench for turning the nut when adjustment is necessary

Combined Nut Lock and Wrench

By L. KASPER

The accompanying sketch shows how, by a simple expedient, a nut may be locked against turning, the locking attachment itself serving as a wrench when turning is desired. A threaded rod passes through a bar, the nut being used for making adjustments. A channel-shaped piece having a square hole in the center is dropped over the nut, the legs of the channel engaging the edges of the bar, thus locking the nut against rotation. When adjustment is necessary the channel piece is lifted up clear of the nut and is turned over with the legs uppermost, thus providing a wrench with which the nut can be turned.

One-Operation Die Forms Split Tubes

By GEORGE K. SCHRAY

We had a problem to make a tube which had to be held within 0.003 in. on the diameter. Seamless steel tubing was prohibitive because of the cost, and a seam was not objectionable as long as it was closed tightly. The protruding parts of the notched end of the tube shown in the drawing had to be formed and spaced so that they could easily be pushed through punched slots in the back of the instrument in which it was to be used. Furthermore, it was necessary to have a narrow bulge clear around the tube and large openings at the other end to permit quick circulation of air. These specifications are added to show that with all these punched holes and formed ribs in the blank, the die described here worked without a miss of any kind.

The blank should be parallel to insure a uniform diameter of the tube. We used a cut-off blanking die, which also trimmed the blank to the exact width. The die consists of the bottom *A* and the top *B*. The

mandrel *C* is carried by two bearing blocks *G* which are each fastened to the ends of part *A*. Pressed into part *A* are a series of pins *D* for which clearance holes are provided in *B*. These pins should be placed close to the edge of the half-round contour of *A*. The number, diameter and position of these guide pins are determined by the shape of the blank.

In operation the blank *I* is inserted between the mandrel *C* and die *A*. When the top part *B* of the die descends the blank slides along the contour of *B* until it strikes pins *F*. These pins, which were spaced about 1 in. apart for 16-gage steel stock, are filed off on one side parallel to the axis to have a broader surface of contact. These pins push the blank between mandrel *C* and die *A*. Were it not for pins *D* the blank would buckle enough to protrude far over the point *X*, which would no doubt have a disastrous effect when the die closes. To insure no shifting of the blank which would bring the top edge of same on the outside of point *X*, we provided the two outside pins *D* with special spring *E*.

Because the mandrel is mounted loosely in *G* it will turn as the blank moves around in the space between *C* and *A*. The blank will more or less follow *C* and in closing strike the bevelled end of the pins *F*, thereby forcing them into *B*. Because a solid squeeze will close the tube tightly it is advisable to make the halves in *A* and *B* shallower than half the outside diameter of the tube. We also found that the slight rounding of *X* and *Y* and opposite edges in *A* prevents any scoring of the blank.

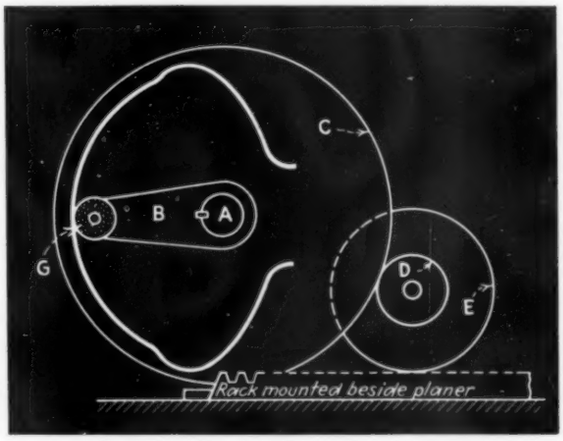
Care should be taken to mount the mandrel freely so that the finished part can be removed easily; this was done as shown in the perspective sketch. The mandrel is turned down on each end to serve as bearings and handles. The shoulders fit between the bearing blocks *G* and prevent end play. The sides of the hardened blocks *G* serve as guides for the blank and should not be spaced much farther apart than the length of the blank. The bearing blocks were slotted as shown and the mandrel was held by pins *H*.

After the tube was formed those two pins *H* are partly withdrawn, the mandrel taken out and the finished part removed. By making the diameter of the mandrel a few thousands undersize we found that it greatly helped the stripping of the tube and also took care of the variation in the thickness of stock.

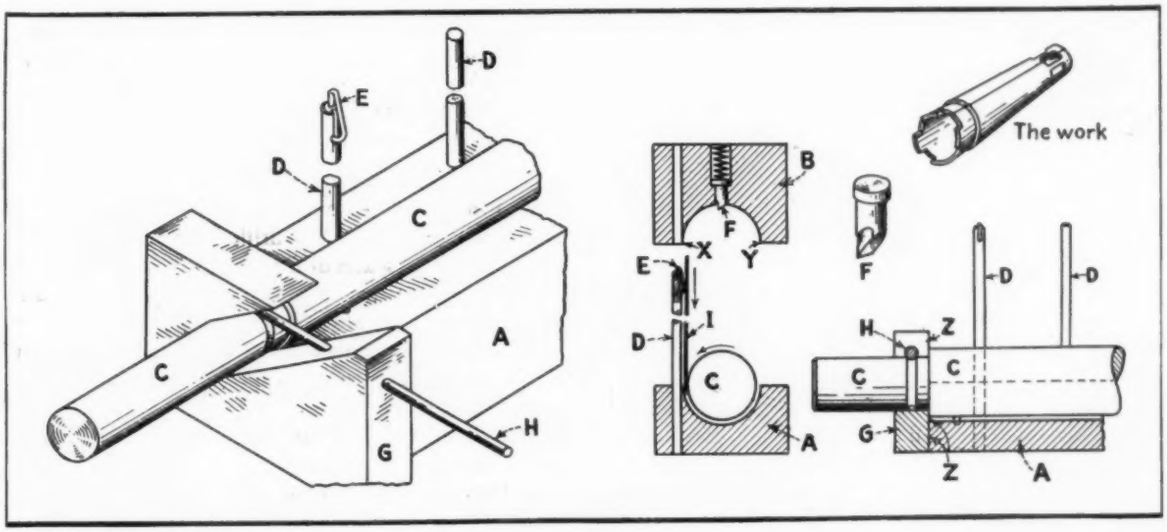
Grinding an Inside Segment

By FRANK C. HUDSON

Several large castings for a special job had an inside segment of a circle that had to be ground to true and to a good finish. The inner surface of the casting is shown by the heavy white line in the draw-



This train of three gears, operated by a rack on the planer table, oscillates a grinding wheel for finishing a radius on the inside of large castings



A split tube can be formed in this die in one operation by inserting a parallel blank between the mandrel and the die shoe. As the die descends, the blank slides along the contour of the die and is held to within 0.003 in. variation on the diameter by the mandrel

ing. The outside is not important except that it had a flat side which could be bolted to the planer table. The problem was to oscillate the grinding wheel *G* through the proper arc and feed it across the face of the work.

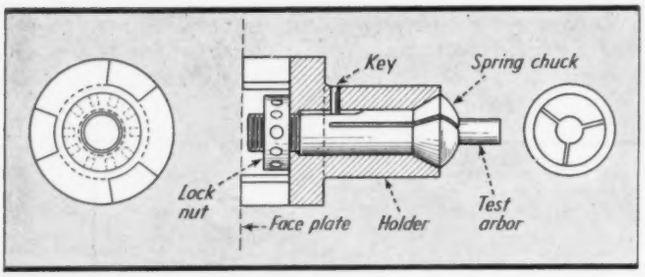
The splined shaft *A* was large enough to prevent springing and was mounted in substantial supports at each side of the work castings. It carried the arm *B* which supported the small, motor-driven grinding head *G*. The spline and key permitted the arm to be fed across the work by a star feed.

Oscillation of the grinding wheel was secured by a rack, supported beside the planer table, meshing with the gear *E* of the three-gear train. With the grinding head driven by its own motor, through a flexible power line, the planer table moves the work back and forth at slow speed. The rack beside the planer drives gear *E*, while *D*, mounted on the same shaft, drives the gear *C* and swings the arm *B* with the grinding wheel through the necessary arc. By setting the planer table dogs at the right points the arc of travel can be regulated very closely.

Holder Makes Spring Collets Run Through

By GEORGE J. MURDOCK

Due to wear and hard usage, spring-collet chucks will often fail to run perfectly true. This is sometimes aggravated by the worn nose of the lathe spindle. Then too their use is generally confined to work concentric with the axis of the spindle, making it impossible to turn or grind work that must be eccentric. To circumvent these defects the illustrated independent collet



This spring-collet holder can be mounted on a face plate or held in a three-jaw chuck. Once set, the collet will always run true

holder was designed for use with the face plate or independent three-jaw chuck.

It is placed in the chuck, or strapped to the face plate, after which a testing rod or plug is placed in the collet. The base shifted if in a chuck, or moved over if on a face plate, until it is shown to run true by an indicator. The test plug is then removed, and the work to be turned or ground substituted with the certainty that it will run true even if removed from the chuck and replaced for final machining operations, or turned end for end.

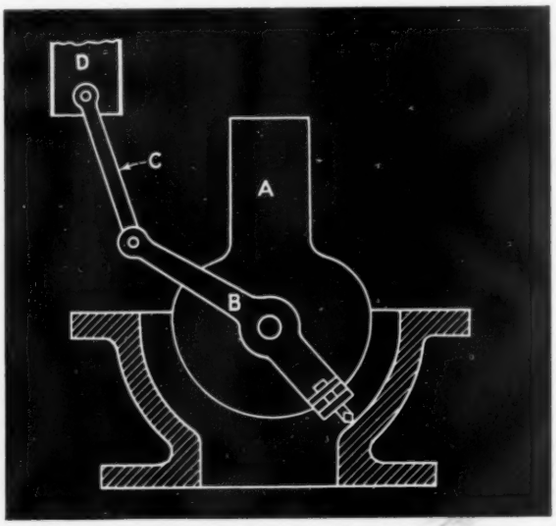
This holder is also useful for holding spring collets on the dividing head of the milling machine, or on surface grinder for it is self-contained. It requires no draw-in spindle, the chuck being tightened on the work, or released by the use of a pin inserted in the rim of the locknut in holes provided for that purpose, as shown in the drawing.

Preferably it is made of tool steel hardened, and ground at all important bearing surfaces, but it may be made of cast iron, or of machine steel, pack hardened.

Pivoted Fixture Bores a Ball-Socket Joint

By FRED H. COLVIN

Having an order for some large ball sockets for pipe joints we picked a boring mill with two rams to do the job. The tooling method was simple, but effective, as shown in the drawing. A heavy plate *A* was flame cut to about the shape shown, and hole



A number of large ball-socket pipe joints were bored by feeding downward the left-hand ram of the boring mill to which was attached this pivoted tool holder. The pivot member was mounted on the right-hand ram

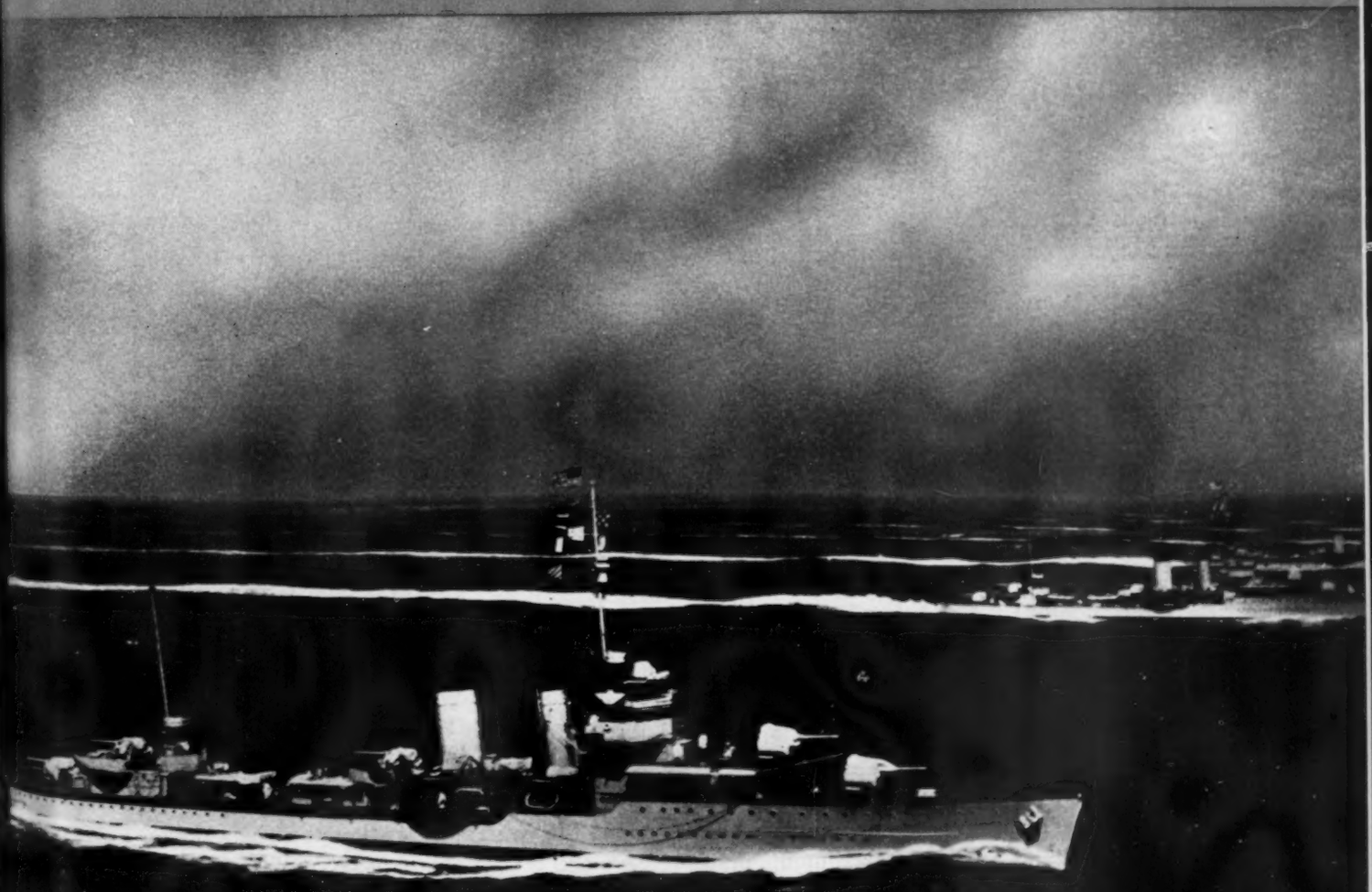
drilled to pivot the tool-carrying bar *B*. The arms, *B* and *C* were flame cut and drilled for the connecting pins. The driving arm of *B* was not 180 deg. from the tool end but was put at an angle to equalize the arc of arm movement around the pivot pin in *B*. Plate *A* was bolted to the tool block of the right-hand ram of the boring mill. Arm *B* was attached to the left-hand ram by link *C*.

The right-hand ram, carrying the tool plate *A*, was set so as to bring the center of the pivot pin in line with the upper flange of the work. Tool movement around the pivot pin was secured by feeding the left-hand ram down. Cutting tool adjustment was made by tapping the tool on the back end with a hammer. This rig proved very satisfactory on this work.

Armament

SECTION OF AMERICAN MACHINIST

TOOLS FOR NAVY TURBINE BLADES



TOOLS FOR NAVY TURBINE BLADES

Shops equipped only with standard machine tools can machine turbine blades by using the special fixtures developed by the New York Navy Yard and described in this article

THE NAVAL EXPANSION PROGRAM is in full swing. The ultimate goal is 800 warships and auxiliary vessels for a two-ocean navy. Turbines for these ships are produced by private manufacturers and navy yard shops, but subcontractors are supplying many parts in semi-finished or finished form. Among the latter, and probably one of the most important items, is turbine blading, machined to exacting tolerances and specifications.

The blades are made from corrosion-resisting steel stipulated in U. S. Navy Department Specification 46S12d as Class "a" material, heat-treated for machining. Rectangular bars for these blades must be delivered straight, straightening after final heat-treatment being prohibited. They are ordered to exact lengths so they can be cut to the length of blades in various turbine stages without excessive waste.

The steel must be made by either the crucible or electric process, and each lot of bars submitted for inspection must be poured from the same melt and heat-treated in the same furnace charge. Hardness must be 200-240 Brinell or 15-24 Rockwell C. Chemical requirements are as follows: carbon, 0.06-0.13 per cent; manganese, 0.25-0.80; phosphorous maximum, 0.03; sulphur maximum, 0.03; silicon maximum, 0.50; chromium, 11.5-13.0; nickel maximum, 0.50. Tensile strength required is 100,000 lb. per sq.in., while the proof stress, determined by use of an extensometer, must be 70,000 lb. per sq.in. and must not produce a permanent set of more than 0.0002 in. in 2 in. upon removal of the load. Specified elongation in 2 in. and reduction of area are 20 and 60 per cent, respectively.

The New York Navy Yard is manufacturing turbine blades for naval vessels, using fixtures made at the yard for use on standard machine tools. The fixtures and machining operations for producing blades for one high-pressure and one low-pressure stage of one turbine for a naval vessel are herein described. However, fixtures for blades in other stages are similar to those shown here, varying only in dimensions to accommodate different blade sizes.

The rectangular stock for the blades comes to the shop in specified lengths, depending on the number of blades to be cut from each bar. The width and thickness is also specified for each stage, with $\frac{1}{16}$ in. allowed for machining. Each bar is tested in at least three places for hardness before machining starts.

High Pressure Blading

The blades for turbines with eleven high-pressure stages vary in height from ½ to 3¼ in. and have straight, rather than helical, concave and convex steam passage surfaces; however, in fourteen-stage turbines the blades in the last few stages may have helical steam-passage surfaces. The bar stock for straight-surface blades is cut into lengths from which two, three or four such blades can be pro-

duced. The top, bottom and sides of each length is ground square with each other to finished dimensions and held to tolerances of +0.000 in. and −0.001 in. One end is then faced square with the ground surfaces, leaving one end unfinished.

This piece is placed in a fixture for milling the convex side of the blade, the squared end of the stock and the ground sides being used to locate it. The fixture is shown in Figs. 1 and 13, the latter illustrating the profiling of low-pressure blades. The profile on high-pressure blades, and the operations in succeeding fixtures are indicated in Fig. 2.

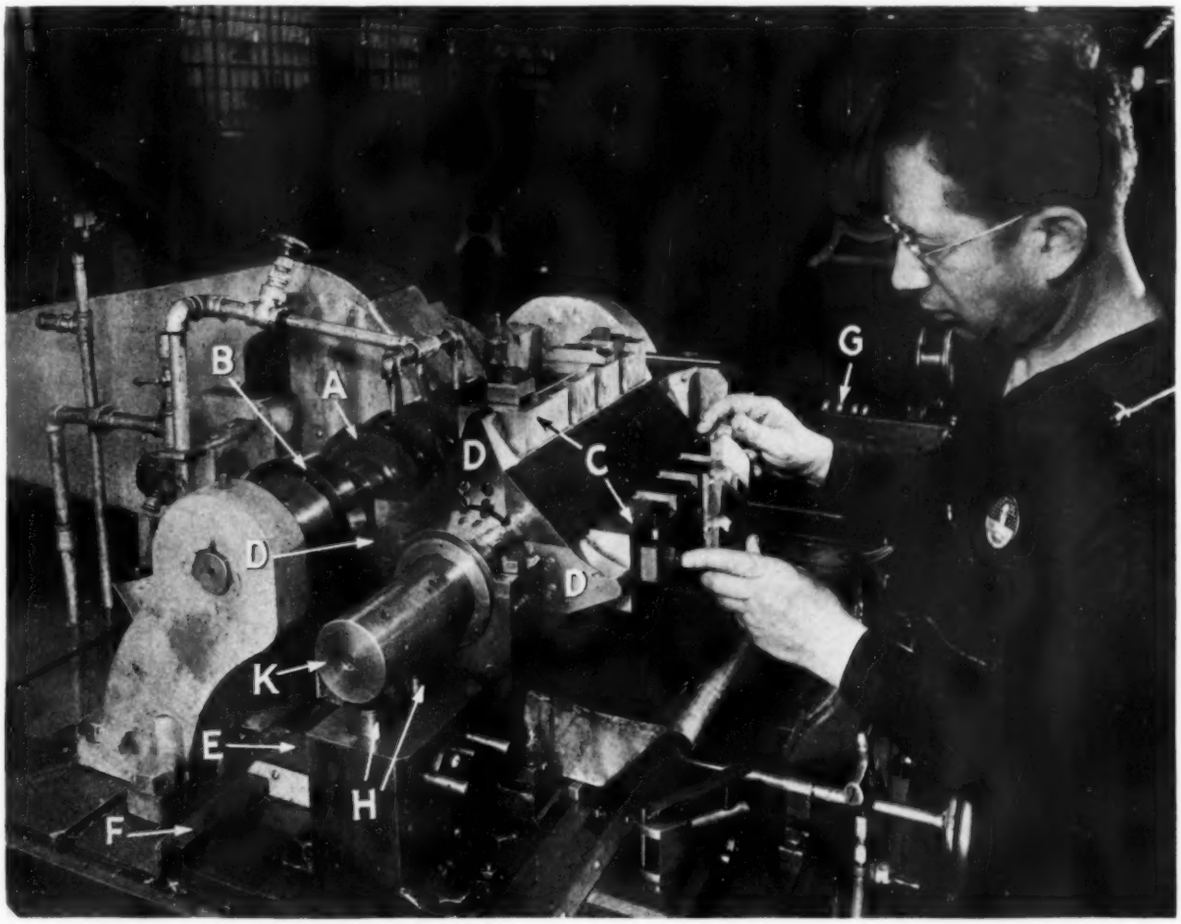


Fig. 1—The back of the blades is machined in a fixture having four blade holders and four cams; the contour of the latter is that of the convex profile produced on the blade. The fixture is mounted on a sliding table and is held against the cutters by a leverage system actuated by air pressure

The profiling machine and fixture shown in Fig. 1 for machining the convex side of the blade consists essentially of the milling cutter *A*, driven by a motor beneath the table, the roller *B* mounted on the cutter arbor, the blade holders *C* of which there are four, and th cams *D* the shape of which conform to the profile on the back or convex side of the blades. The fixture with blade holders and cam followers are mounted on a table *E* which is movable transversely; table *E* and the blade holder are mounted on a table *F* movable longitudinally. Table *F* is connected by levers to an air cylinder beneath the table. The pressure required to hold the blade against the cutter varies from a minimum to a maximum and back to a minimum as the profile of the convex side, indicated as operation No. 4 in Fig. 2, is being machined. The air pressure in the cylinder beneath the table, and therefore the longitudinal forces on the table *F* exerted by the leverage system, is varied by a differential air-pressure valve *G* attached to the fixture and operated from a cam on the

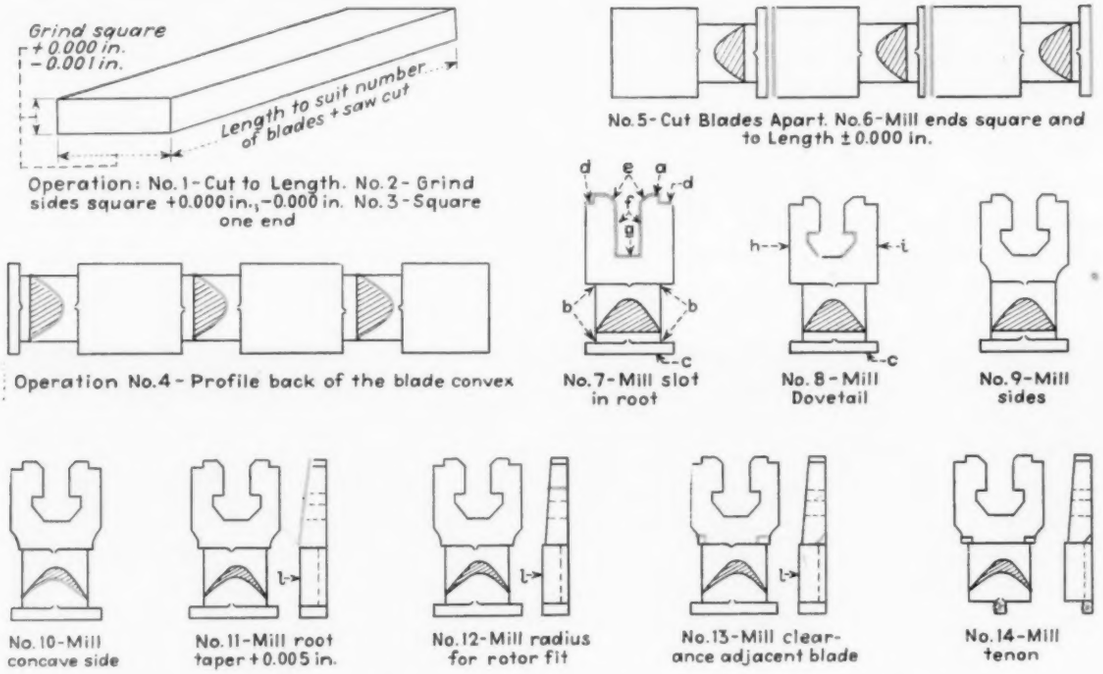

Grind square
+0.000 in.
−0.001 in.
Length to suit number of blades + saw cut
Operation: No. 1 - Cut to Length. No. 2 - Grind sides square +0.000 in., −0.000 in. No. 3 - Square one end
No. 5 - Cut Blades Apart. No. 6 - Mill ends square and to Length ±0.000 in.
Operation No. 4 - Profile back of the blade convex
No. 7 - Mill slot in root
No. 8 - Mill Dovetail
No. 9 - Mill sides
No. 10 - Mill concave side
No. 11 - Mill root taper +0.005 in.
No. 12 - Mill radius for rotor fit
No. 13 - Mill clearance adjacent blade
No. 14 - Mill tenon

Fig. 2—These are the operations used at the New York Navy Yard for machining high-pressure turbine blades for a naval vessel. The remaining operations are grinding the root taper to finish size ±0.000 in., sanding and polishing concave and convex sides of the blade, magnaflux test for flaws, nitric-acid test the material, and inspect for size and rotor fit

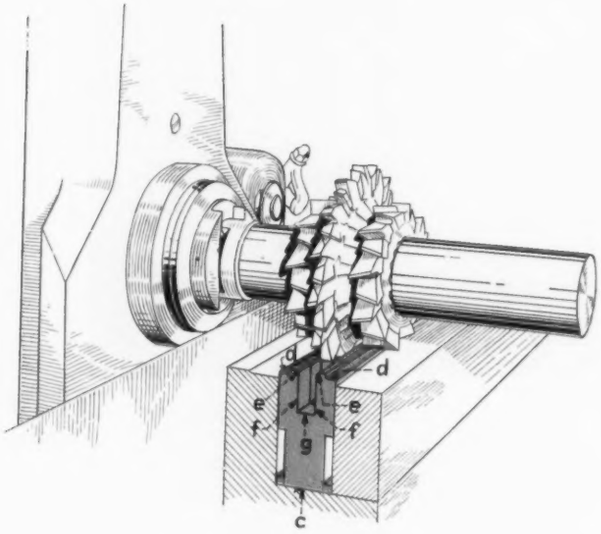


Fig. 3—Slots in the roots of the blades are milled with 16 blades in the fixture. In this and all other fixtures, the blades are located accurately from surfaces previously machined to finished dimensions

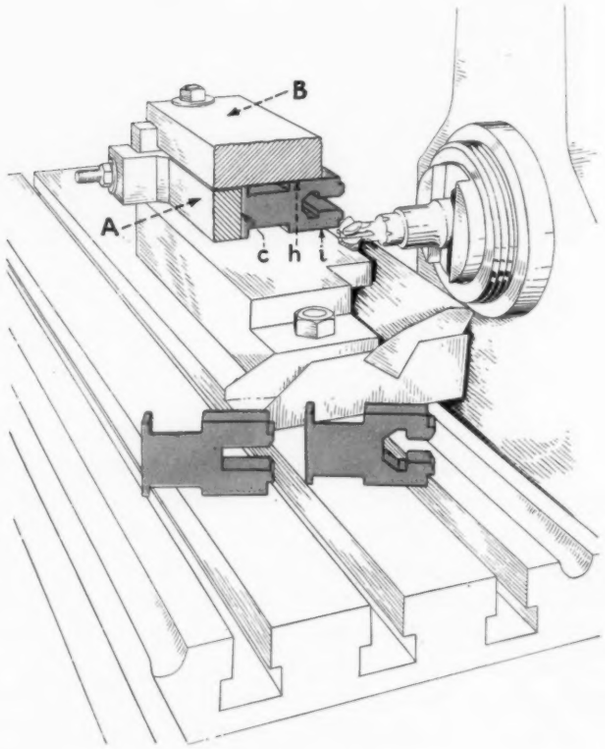


Fig. 4—Rotor dovetail fit is milled in the root of each blade after machining a slot for clearance of the cutter shank. Operations Nos, 7, 8, 9, 11 and 13, all indicated in Fig. 2, are done in clamping fixtures similar to the one shown here

cutter arbor; this valve is shown in the foreground in Fig. 13. In all cases the convex side of the blade is an exact reproduction of the cam, each of which is made the shape of the blade required, ± 0.000 in.

Transverse movement of the table *E* is required when profiling helical-shaped blades, in which case the profile adjacent to the root is not parallel with the root and tenon ends as explained in conjunction with Fig. 13. Such movement of the table *E* and therefore the blade holder, is accomplished by a cam on the end *K* of the blade-holder spindle; however, the cam is not shown in Fig. 1. The cam is actuated by pins *H* set in a block bolted to table *F*.

When more than one blade is made from a single piece of rectangular stock, the profiled bar is slit with milling cutters and the ends milled square with the top, bottom and sides as shown in operations Nos. 5 and 6 of Fig. 2.

Sixteen blades are placed in a fixture for milling the slot in the root as shown in Fig. 3. This operation is No. 7, shown in Fig. 2. Prior to this operation face *a* had been milled square with the top, bottom and sides of the blade, the surface *b* has been machined during profiling, using face *a* and the squared sides as locating edges. Face *c* had been milled square with all other surfaces. In operation No. 7, surfaces *d, e, f* and *g* are milled as shown in Fig. 3 to exact dimensions, using surface *c* and the squared sides of the blade as locating edges. Thus, as machining proceeds in the various fixtures, the blades are located in the fixtures using surfaces previously machined to close tolerances.

In milling the dovetail in the root of the blade, sixteen blades are placed in the fixture shown in Fig. 4. The removable side *A* and top *B* of the fixture clamp the blades on surfaces *c* and *h*, indicated by operation No. 8, Fig. 2, with surface *i* resting on the base of the fixture. The dovetail is milled after the dovetail recess in the front of the fixture is aligned with the milling cutter by proper adjustment of the machine table. Following this operation, the sides of the root adjacent to the profiled section of the blade are milled as indicated by operation No. 9, Fig. 2.

The concave face of each high-pressure blade is milled, in the fixture shown in Fig. 5, using a two-fluted cutter. The blades are located between blocks *A* and *B*, and adjusted for height by block *C*, for which recesses are provided in the movable vise jaw *D*. Single blades are machined to permit chips to fall away from the face of blade and thereby prevent scoring of the machined surface. The depth of the cut is controlled by the adjustable stop *E*, which can be set to precise location by the calibrated nut *F*.

Operation No. 11, Fig. 2, is next performed with sixteen blades in one fixture. The base of the fixture is set at an angle while the face of the milling cutter is in a horizontal plane. The root taper is milled to within 0.005 in. of finished size; the taper on the root is finished

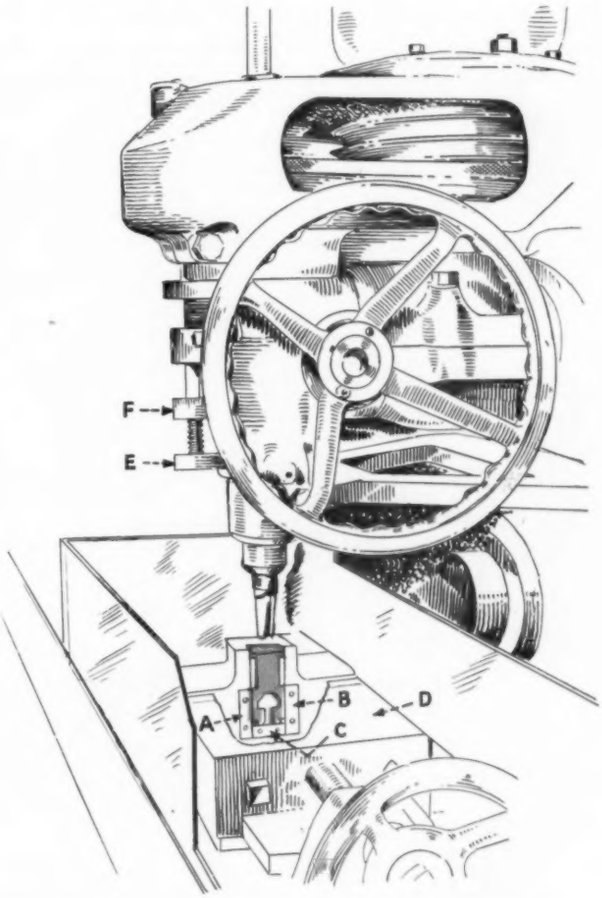


Fig. 5—The concave side of high-pressure blades with straight blade surfaces are milled one blade at a time with a two-fluted cutter. A fixture with two blades face to face was discarded because the chips scored the concave face

by grinding to required thickness, +0.000 in.

One face of the dovetail, operation No. 12, Fig. 2, must be milled to a radius conforming to that of the turbine rotor. The fixture for making this cut is shown in Fig. 6. The blade is located vertically between blocks *A* and *B* and horizontally by screw *C*. The blade root protrudes beyond the blocks *A* and *B* for clamping with swivel blocks *D;* the top swivel block has been removed to show the blade. Bolts *E* extend to the back of the fixture and are fastened to a vertical rectangular bar which bears against a lever operated by an eccentric. This eccentric clamp positions the blade for milling face *k* as illustrated in Fig. 6.

After the root taper has been milled and ground, the edges *l* of the blade shown in Fig. 2 extend beyond the root. When assembled on the rotor, clearance must be cut in the root of the adjacent blade for the protruding edges. Such clearance is shown indicated by operation No. 13, Fig. 2.

Milling of the tenon, operation No. 14, Fig. 2, is done in the fixture shown in Fig. 7. The blade is placed between accurately spaced blocks *A* and *B,* and is located vertically by rod *C* the end of which fits into the finished dovetail in the root. The movable vise jaw *D,* recessed to fit the stationary jaw *F* with the blade and locating block assembly, is operated by air-cylinder *G*. The depth of the cut is controlled by an adjustable stop similar to *E* in Fig. 5.

Following the foregoing milling operation, the root taper is ground to finished dimensions ±0.000 in. The set-up for this operation is shown in Fig. 8. A number of blades from any one stage is placed on a magnetic chuck *A* mounted on a fixture consisting of plane sections *B* and *C* hinged at *D*. The rod *E* is affixed rigidly to section *B* and is fitted with elliptical pieces *F*. The section *C* is bolted to the grinder table. For the blades in each turbine stage, sine blocks *G* are placed between elliptical pieces *F* and section *C;* these sine blocks tilt section *B,* magnetic chuck *A* and the blades to the proper angle for grinding the root taper. The grinding wheel is notched as shown in Fig. 8 to throw off girts, thereby preventing them from adhering to the wheel and scoring the finished tapered surface.

The convex and concave surfaces of all blades are sanded and polished to a bright finish. The entire blade is then subjected to

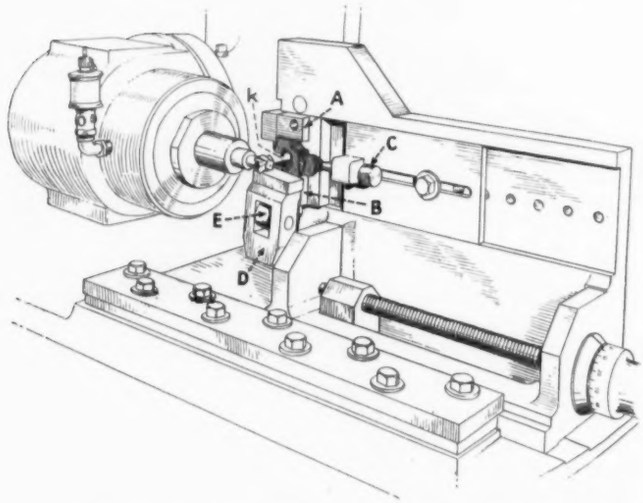
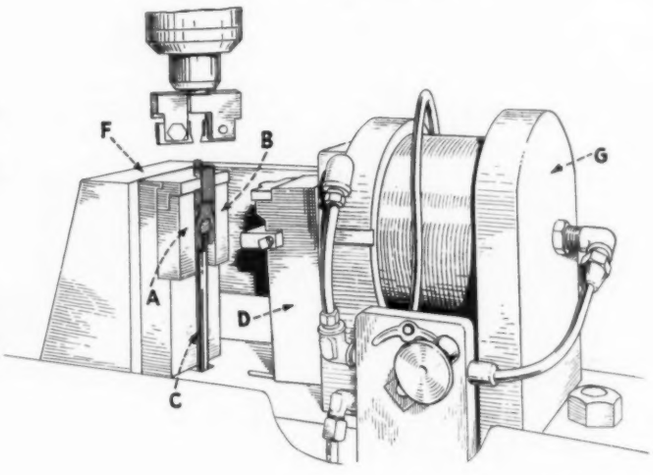


Fig. 6—The dovetail in the blade must be milled with a radius conforming to that of the rotor. Since only a few thousandths of metal is removed in this operation, the fixture has an eccentric clamp for quick application and removal of the blade

Fig. 7—When the tenon on the end of the blade is circular, rather than elliptical, the blade is held in this air-operated fixture and the metal removed with a two-blade inserted cutter. Elliptical tenons are milled in the fixture shown in Fig. 15



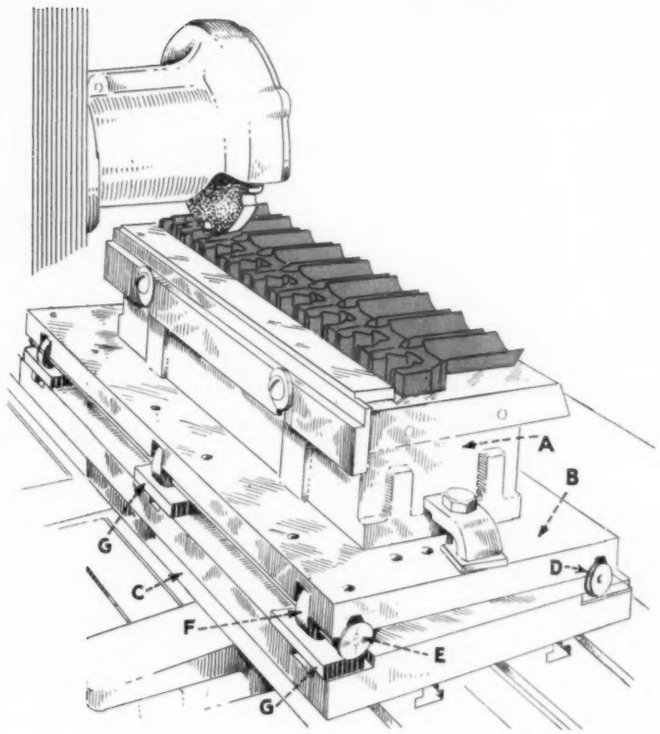
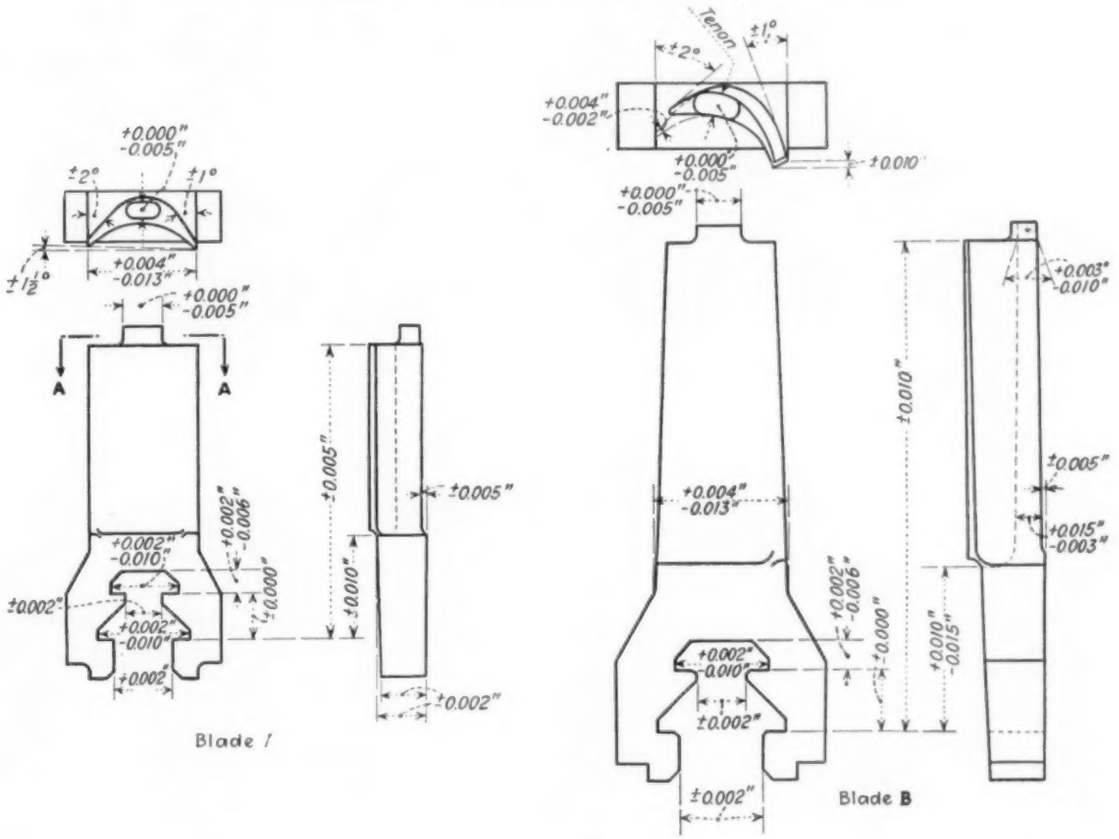


Fig. 8—The taper on the root of the blades is ground to finish size. A group of blades is placed on a magnetic chuck which is tilted to an angle with sine blocks placed under one end of a hinged plate bolted to the grinder table

Fig. 9—The tolerance given are typical of high-pressure blades A and low-pressure blades B. The tolerances are used on inspection gages; milling machine operators work only to actual finished dimensions



a magnaflux test to detect possible flaws. A drop of nitric acid is placed near the tenon to check the material—the chrome steel specified for the blades will not turn black under the action of this acid, whereas other stock in the shop, should it accidentally be used for blading, will turn black. Finally each blade is inspected with go and no-go gages for dovetail rotor fit. Gages are also provided for checking blade length, radial alignment on rotor, root dimensions and taper, contour of the convex and concave surfaces, and tenon dimensions. Permissible tolerances on two turbine blades are shown in Fig. 9.

The shape of the blades described in the foregoing operations have straight concave and convex steam-passage surfaces such as Blade *A* in Fig. 9. In some instances high-pressure blading for the last few stages may have helical concave and convex surfaces such as shown on Blade *B* in Fig. 9; in the latter case, the machining operations are similar to those performed on low-pressure blading described later. Conversely, machining operations of low-pressure blading with straight concave and convex surfaces are similar to those just described for high-pressure blading.

Low-Pressure Blading

When the low-pressure blades become helical in shape, they are usually of such length that only one blade can be machined from the original rectangular stock shown in perspective in Fig. 10. The piece is ground square on the top, bottom and sides, and both ends are faced square with ground surfaces. These three operations, as well as succeeding ones, are indicated in Fig. 10.

A group of ground and faced rectangular pieces are placed in a fixture for milling the slot in the root of the blade. This operation, indicated as No. 4 in Fig. 10, is performed in a fixture similar to that shown in Fig. 3. Operation No. 5, milling the dovetail in the root and the square on the tenon end of the blade simultaneously, is done on a Cincinnati four-spindle Hydromatic miller with the fixture shown in Fig. 11. The blades are located in the fixture by finished faces *a* and *b* shown in Fig. 10. Referring to Fig. 11, the blades

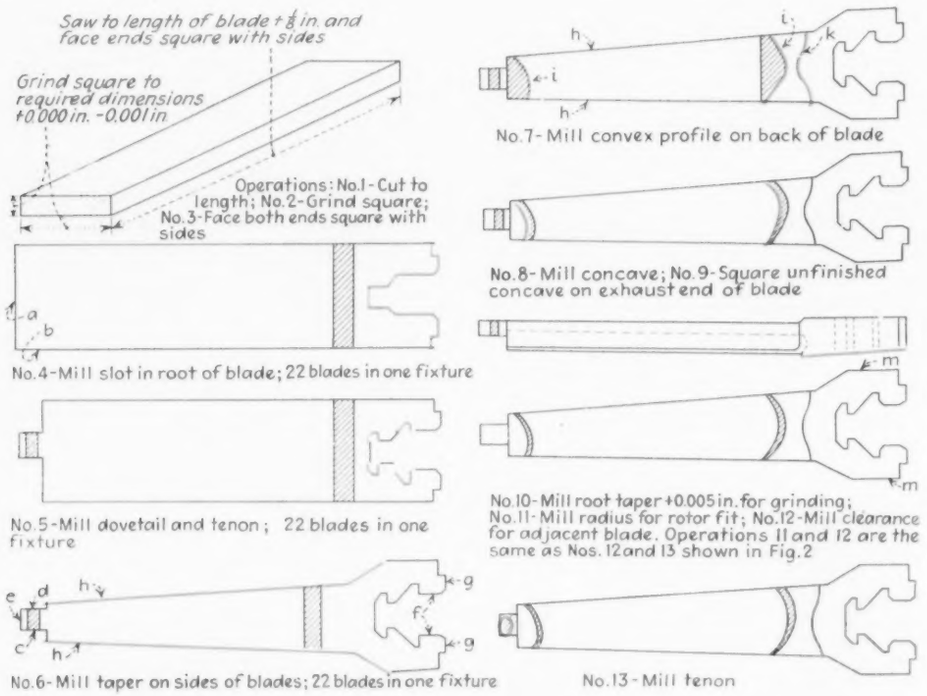

Saw to length of blade + 1/8 in. and face ends square with sides
Grind square to required dimensions +0.000 in. -0.001 in
Operations: No.1-Cut to length; No.2-Grind square; No.3-Face both ends square with sides
No.4-Mill slot in root of blade; 22 blades in one fixture
No.5-Mill dovetail and tenon; 22 blades in one fixture
No.6-Mill taper on sides of blades; 22 blades in one fixture
No.7-Mill convex profile on back of blade
No.8-Mill concave; No.9-Square unfinished concave on exhaust end of blade
No.10-Mill root taper +0.005 in. for grinding; No.11-Mill radius for rotor fit; No.12-Mill clearance for adjacent blade. Operations 11 and 12 are the same as Nos. 12 and 13 shown in Fig. 2
No.13-Mill tenon

Fig. 10—These are the operations for machining low-pressure blades. Other operations are grinding root taper to finish dimensions, sanding and polishing concave and convex surfaces, magnaflux testing for flaws, nitric-acid test the material, and inspect for sizes and rotor fit

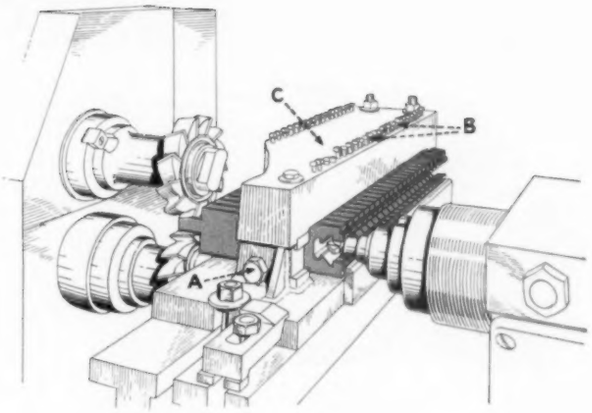
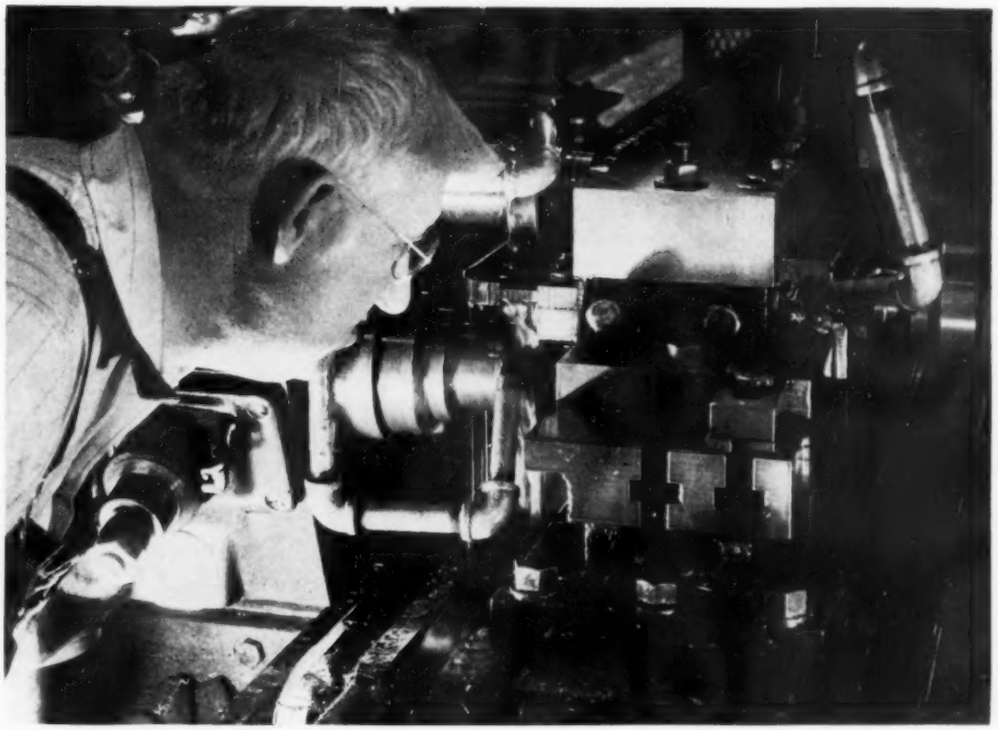
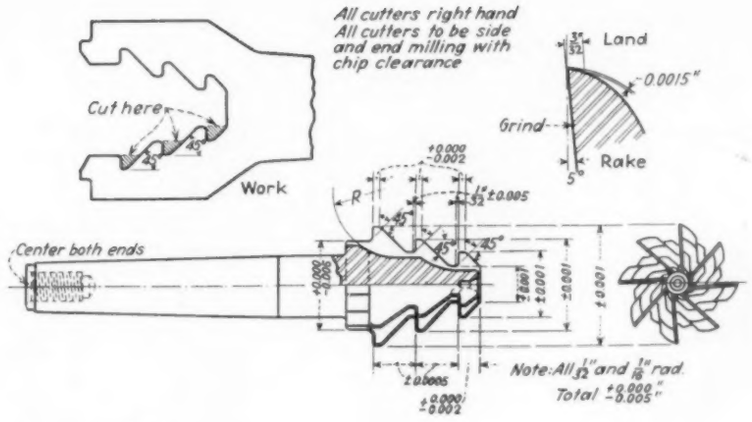


Fig. 11—The dovetail and tenon end of low-pressure blades are milled on a Cincinnati four-spindle Hydromatic with 16 to 22 blades in the fixture. The cutter is for large low-pressure blades with three-step dovetails used in the last stages of the turbine





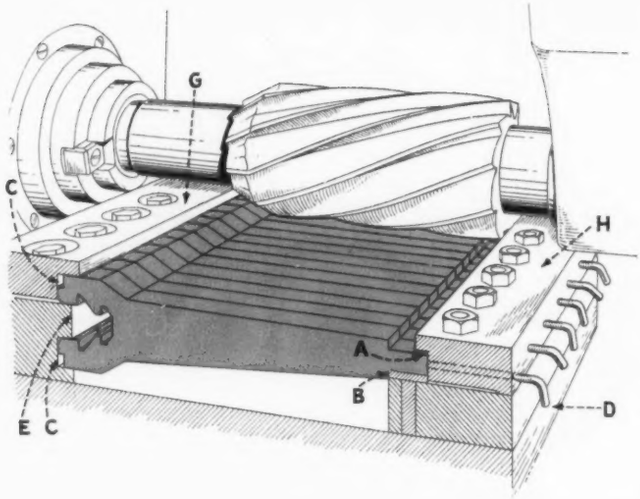
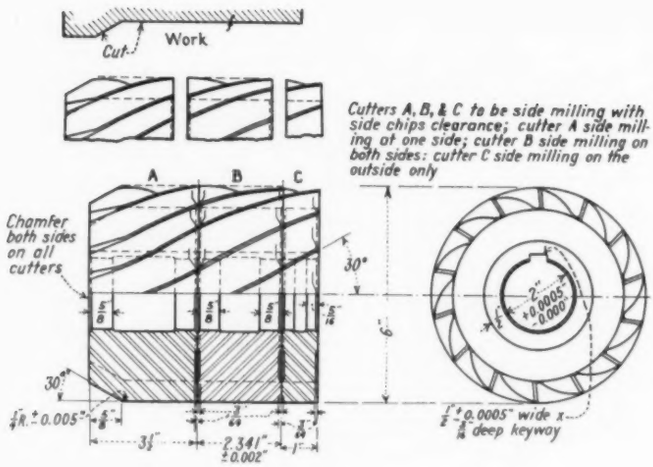
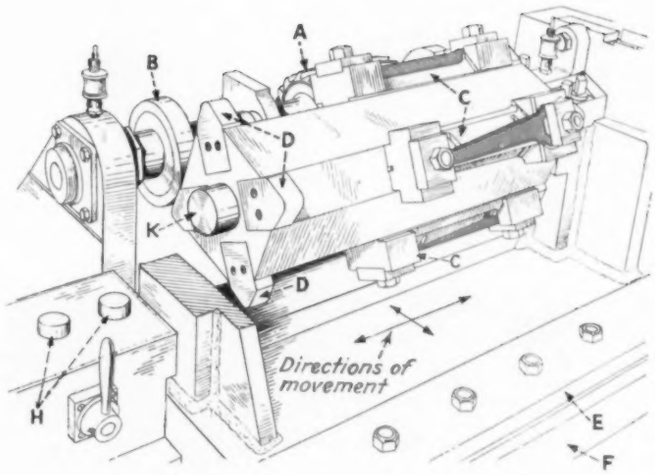


Fig. 12—This fixture and cutter is for milling the taper of the sides of the blades. Liners are placed above and below the tenon because on helical-shaped blades the tenon is not on the dovetail center line. Each blade is held against the back of the fixture by setscrews against the tenon end


Cut
Work
Cutters A, B, & C to be side milling with side chips clearance; cutter A side milling at one side; cutter B side milling on both sides; cutter C side milling on the outside only
A
B
C
Chamfer both sides on all cutters
30°
30°
3½"
2.341" ±0.002
1"
2" +0.0005 -0.000
deep keyway

are clamped horizontally by setscrews *A* and vertically by setscrews *B* in cap *C*, each blade being held by two setscrews. The square on the tenon end of the blade is not on the center line of the dovetail, since the finished blade is to be helical shaped like blade *B* in Fig. 9.

The taper *h* on the sides of the blade, indicated by operation No. 6 in Fig. 10, is next milled with as many as 22 blades in one fixture. The blades are located in the fixture from surfaces *c*, *d*, *f* and *g* previously machined to finished dimensions. The fixture is shown in Fig. 12. Liners *A* and *B* are placed above and below the tenon to maintain the



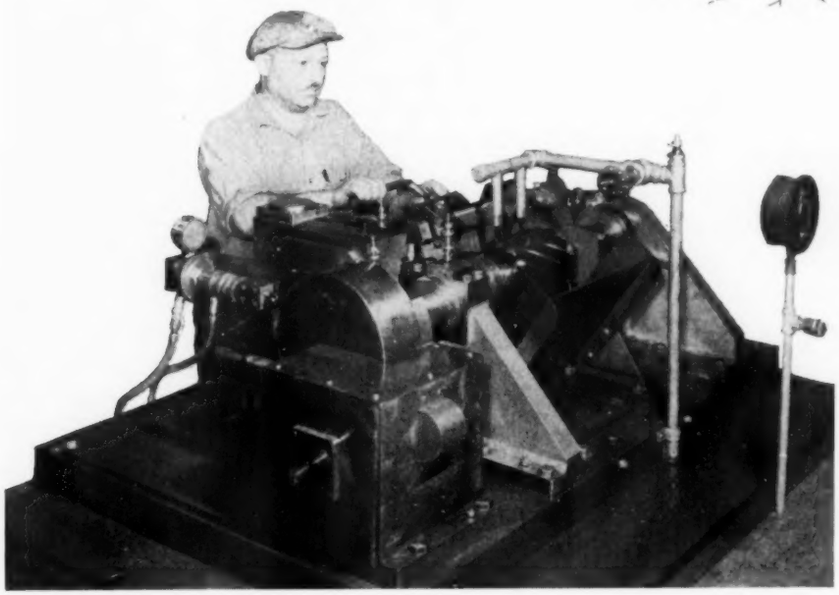


Fig. 13 — Low - pressure blades are profiled convex in the same fixture used for high-pressure blades, but only one blade is machined from one piece of stock and the table moves both longitudinally and transversely to complete the cut. The cutters are interlocked with sufficient clearance in back of the teeth to prevent the chips from clogging

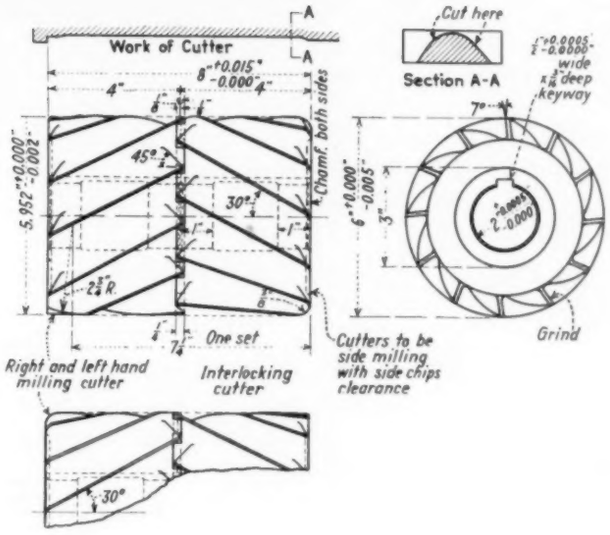
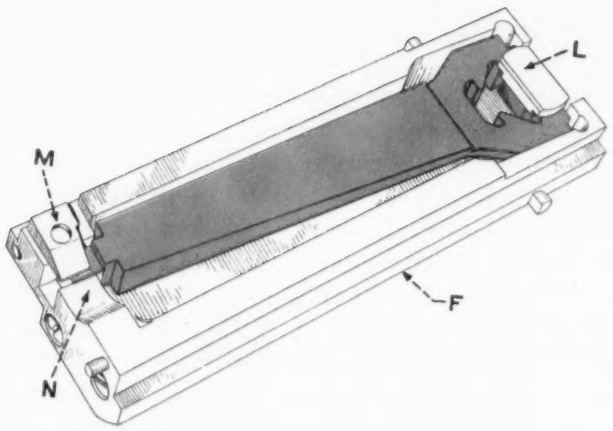
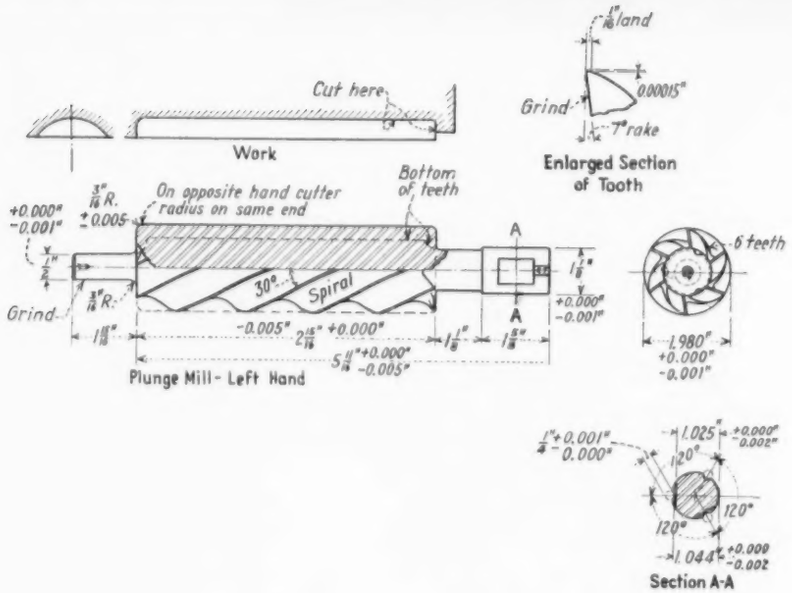


Fig. 14—The helical shaped concave faces of two low-pressure blades are plunge milled simultaneously with a straight cutter. The blade is offset in the holder to produce the helical surface. The fixture has right- and left-hand sliding heads which are advanced against the cutter by right- and left-hand cams operated from the machine table





blades in a horizontal position since the tenon is not on the dovetail center line. The blades are set flush against faces *C* of the fixture, and held there by setscrews *D* against the tenon ends. The fixed bar *E* fits the dovetail slot tightly. The blades are butted against the back of the fixture, held horizontally by screws *D* and vertically by caps *G* and *H*. Studs in Cap *G* are countersunk to clear the cutter arbor. The blades are reversed in the fixture for milling the opposite side.

Special Fixture Profiles Blades

The back or convex side of blade is profiled in fixture shown in Fig. 13, also illustrated in Fig. 1. The cams *D* are the exact contour of the blade profile desired, and bear against roller *B* on the cutter arbor by a leverage system moved by an air cylinder and controlled by differential air pressure as explained previously. The blades fit tightly into the holders *C*, the fits being along sides *c*, *d* and *e* of the tenon end, *f* of the dovetail end, and tapered sides *h*, all of which are indicated in Fig. 10. The table *F* moves backward and forward to cut the profile *i* and the table *E* moves transversely to cut the contour *k;* the cam which moves the table transversely is timed with the profile cams and produces contour *k* simultaneously with the convex surface *i*.

The concave side of helical blades is milled with the fixture shown in Fig. 14 on a Cincinnati Hydromatic milling machine. The crossbeam *A* is mounted to the overarm of the machine and supported on each side of the base by struts *B*. The center line of the crossbeam *A* is in line with the center of the cutter spindle. Two sliding heads *C* and *D*, with machined V-ways to mate ways in the crossbeam, are provided with T-slot heads *E* in which are inserted the two blade holders *F*. Heads *C* and *D* are driven by the crank motion of arms *G* connected to left- and right-hand cams *H* driven by gears *I*. Two hardened-steel racks *K*, bolted to the machine table, mesh with the gears during motion of the table. The cams on each side of the sliding heads decrease the feed of the work as it advances against the center of the cutter and

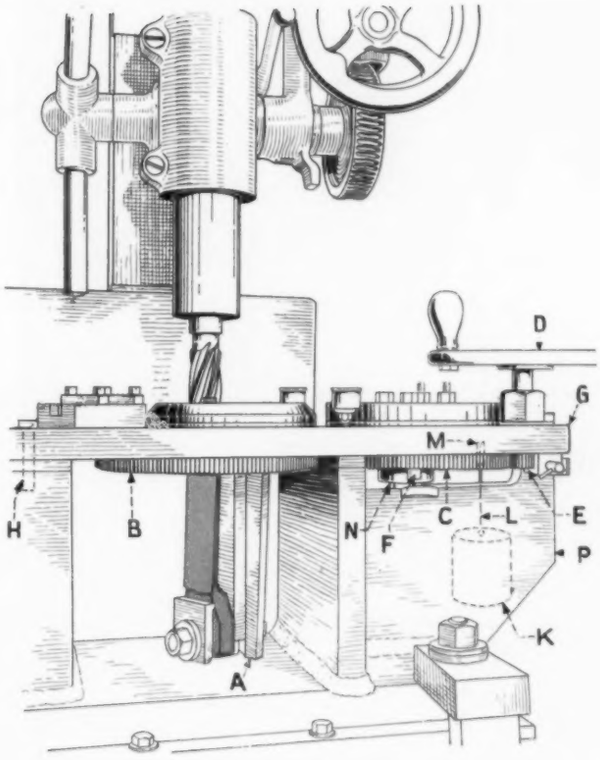


Fig. 15—Elliptical tenons are milled in a fixture with a pivoted top to which are attached a geared blade holder and a geared cam having the same shape as the tenon. The cam moves against a fixed roller which causes the top of the fixture to swivel about its fulcrum and generate a movement at the face of the cutter similar to that of the tenon cam

the finish depth required. A positive stop prevents the work from advancing more than a predetermined amount; after this, the cutter will make 30 revolutions to clean up the cut. Afterwards, the table reverses and the cam action opens the sliding heads rapidly to stop position for removal of the blades.

The blades are offset in the holders as shown in the perspective drawing in Fig. 14, the fit being along one of the tapered sides *h*, on surfaces *c*, *d* and *e* of the tenon, surfaces *f* of the dovetail slot, and surfaces *m* of the blade root; all these surfaces are shown in Fig. 10. The blade is held in the holder by swivel clamps *L* and *M*, and is forced to the left against the tapered surfaces. The plunge milling cuter revolves around the center line of the holder, and by virtue of the position of the blade in the holder mills the helical form of concave face as shown on blade *B* in Fig. 9.

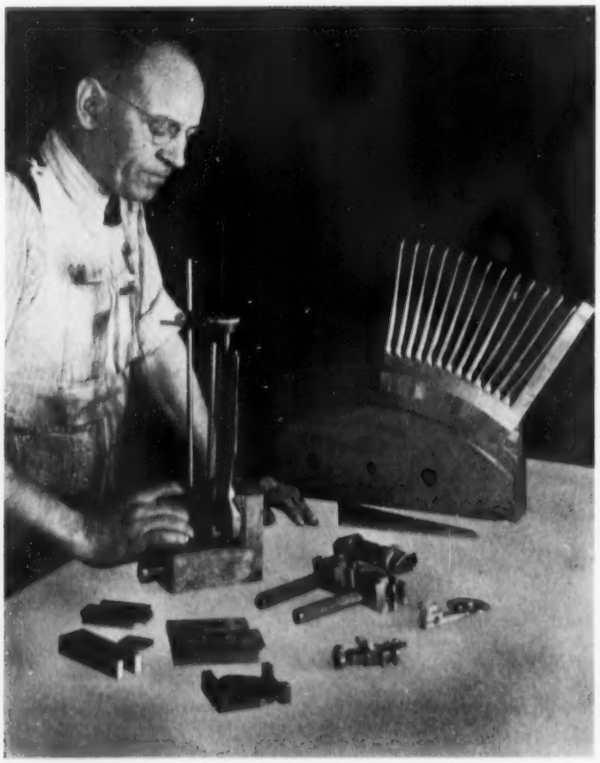


Fig. 16—Each blade is checked for length, root dimensions and taper, contour of the convex and concave surfaces, and tenon dimensions. Segment gages are used to check assembly and radial alignment on the rotor

Clearance for the cutter is at *N*, Fig. 14.

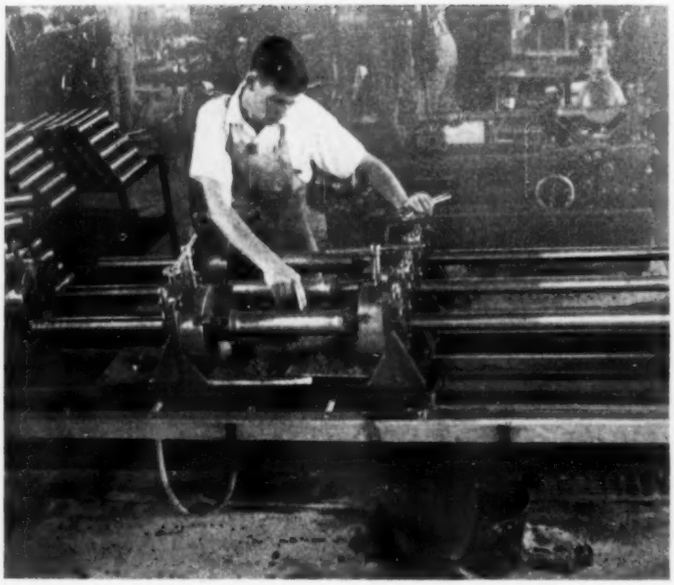
The last milling operation is the machining of the elliptical tenon. This is done with the fixture shown in Fig. 15. The blade is placed in holder *A* so that the tenon projects above the surface of the gear *B* exactly in the center. Gear *B* meshes with gear *C* which is hand operated with wheel *D* and pinion *E*. At the center of gear *C* is a cam *F* of hardened steel machined to the exact shape and twice the size of the tenon desired on the blade. All of these parts are rigidly attached to the plate *G* which pivots about pin *H*. To plate *G* is attached weight *K*, by means of cable *L* and sheave *M*. As the plate pivots about pin *H* it is stopped by cam *F* when the weight *K* pulls the plate against roller *N* which is set on a shaft in the solid base *P*. The distance from pivot pin *H* to the center of gear *B* is one-half the distance between the pivot and the center of gear *C*. It is because of this ratio that the tenon cam *F* is exactly twice the size of the tenon desired on the end of the blade. In operation, the machinist rotates handwheel *D* which moves the tenon cam *F* against the roller *N*, thereby causing plate *G* to swivel about the pivot *H* and generate a movement at the face of the cutter similar to that of the tenon cam as the latter turns against the roller. One complete revolution of the gear *B* is required to machine the tenon.

Finally the taper of the root of the blade is ground on the fixture shown in Fig. 8, as described previously. The blades are inspected for size and rotor fit, and tested for proper material and flaws. Some of the test gages are shown in Fig. 16.

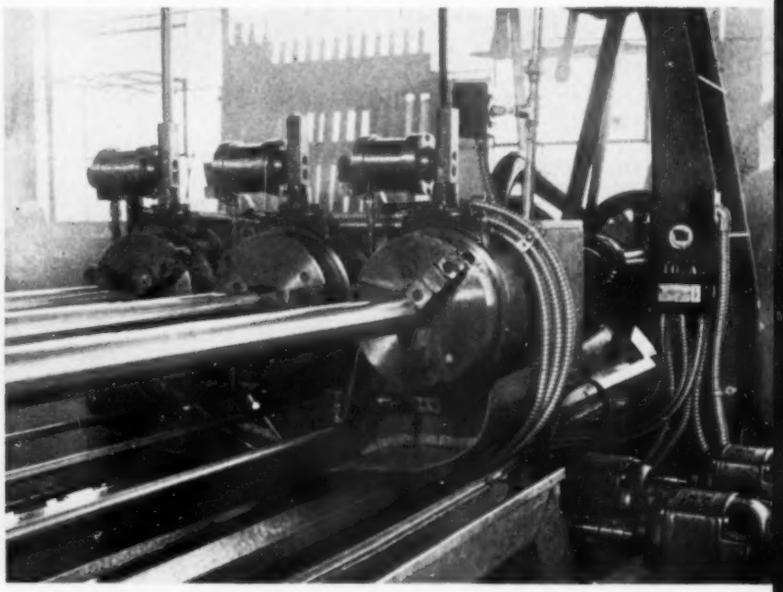
THREE CYLINDERS FROM A SINGLE LATHE

By WALTER M. SCHINDLER

Production Engineer, Bendix Aviation, Limited



Rear chuck slides back off the boring bar to permit reloading of cylindrical parts in this triple-cylinder boring lathe. Cylinders of different lengths and diameters can be bored simultaneously



Gear box is provided with three air-operated Barker wrenchless chucks. Rods underneath boring bars run from sliding work-holding tables to actuate triggers beneath chucks

HYDRAULIC CYLINDER MANUFACTURE is a special problem in aircraft air-oleo shock strut and actuating cylinder production, as the cylinders must be machined with high accuracy at a greatly accelerated rate.

Although these cylinders vary considerably as to size, most are made in a standard way. Seamless heat-treated chrome molybdenum tubing is fed through a turret lathe, machining the outside diameters—commonly consisting of a relieved center portion with raised ends. The cylinder is end faced in the turret lathe and then chucked in a lathe for boring. This operation removes $\frac{1}{32}$ to $\frac{3}{16}$ in. of metal, depending on the size of the cylinder and the tubing stock available, and the bore is then finished on a Barnes honing machine.

Chucking cylinders in the conventional way is somewhat tedious, and the boring operation is difficult to perform satisfactorily unless the boring bar is supported at both ends and carefully centered with respect to the cylinder outside diameter. The cylinder cannot be clamped too tightly or it will spring in the chuck and then be out of round after boring. To solve these problems Bendix Aviation has developed a satisfactory special lathe to bore three cylinders simultaneously. Cylinders may be of varying lengths and diameters in any given set-up, without impairing efficiency.

The first attempt to develop a machine of this type resulted in a single-spindle tool built on a Rockford lathe. This machine proved satisfactory and is still in use. The cylinder

is carried in a pair of self-centering cam clamps supported from brackets mounted on the lathe table. To set up a cylinder boring job in this machine the boring bar is flexibly fastened in the spindle and steel centering rings are slipped along the bar so that the self-centering clamps may be tightened to center the boring bar. The two sets of three support rollers are now adjusted tight against the bar at each bracket. The upper roller is then loosened, the support bracket drawn back, the steel bushings removed and the cylinder slipped in place and clamped by the two self-centering cam clamps. The roller supports are automatically returned to position, being mounted on the cylinder clamp support brackets, and the top roller on each bracket is tightened back until it just contacts the bar. This method results in accuracy, but it is too slow.

The triple-cylinder boring lathe was developed as a result of the experience gained in designing, building, and operating the tool just described. This machine, built on a 16-ft. lathe bed, permits boring any size cylinder from 1 in. diameter and 6 in. long, up to 6 in. diameter and 40 in. long. These two extremes can be bored at the same time if necessary, although normal operation calls for set-ups of cylinders of the same size.

A special gear box drives three Barker wrenchless chucks which grip the boring bars. A special table carries three pairs of brackets which are dovetailed to the table for adjustment to cylinder lengths. The tail brackets slide back off the end of the boring bars and swivel for quick removal of the work. Each of the six cylinder-support brackets carries a chuck and a set of three boring bar support rollers. After selection of the appropriate boring bars for the cylinders to be machined, the bars are chucked in the wrenchless chucks and then both cylinder support chucks are tightened against each bar. While the chucks hold the bars in position the bar support rollers are adjusted snugly against them. The chucks are then released, the cylinders inserted and chucked, and the work is ready to proceed. The upper of the three support rollers is released to slide the rear chuck and bracket off the bar for work handling. The table supporting the brackets feeds away from the lathe head during the boring operation so that, when the work is finished, the rear bracket is near the end of the bar and removal of the work is simplified. Total load and unload time for three cylinders averages not more than fifteen minutes. Time to make a new set-up runs between one and two hours. The cutting tool is a Davis expanding block cutter held in a slot in the boring bar by a single centering screw which permits quick tool removal for cylinder loading.

The chucks in the gear box which drive the boring bars can be operated while running by an air cylinder control or by hand. Each boring operation is controlled by a suitable cam carried on a rod running from the lathe table to the lathe chuck air valve trigger. As the table moves out each cam is brought into contact with the trigger when boring is finished. The corresponding chuck then releases automatically and its boring bar lies idle in its support rollers, moving with the table, until the remaining boring operations are concluded. Of course, when the cylinders are all equal length, operation of the wrenchless chuck controls is practically simultaneous.

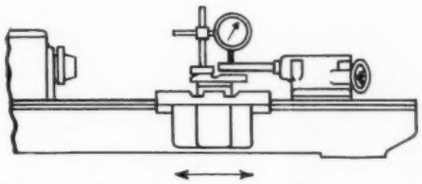
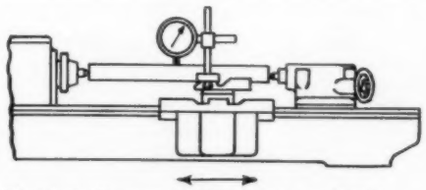
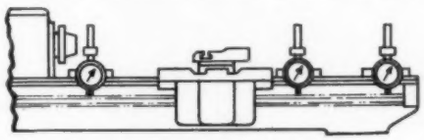
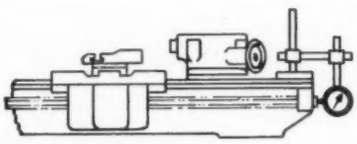
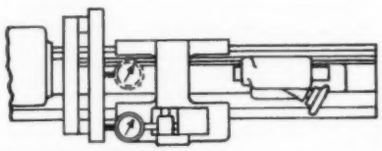
Since some cylinders are quite long the chip removal problem is serious. To solve it coolant is pumped through each boring bar to an outlet at the tool under 50 lb. pressure, which carries away chips satisfactorily. Space is provided between the cylinder chuck and boring bar support rollers to permit these chips to escape. To avoid splashing from the high-pressure oil system as each boring bar is released, a separate micro-switch control on each chuck stops the motor driving the coolant pump for that particular boring bar. Coolant oil flows back to a 30-gal. tank, where chips settle out before the oil reaches the screens protecting the pumps. Oil is fed into the gear shafts which carry the chucks by oil boxes having two oil seals each, through radial holes into the shafts, then inside the chuck and from there into the boring bar. The same gear shafts also carry adjustable friction brakes to keep gear backlash from the boring bars. The hollow boring bars are sealed in the chuck by a set of National oil seals, the bar being thrust into position through the seals when it is chucked. All boring bars have the same diameter at the chucking end so that the oil seals do not need to be changed. The boring bar support rollers are also protected by seals to keep chips from damaging them.

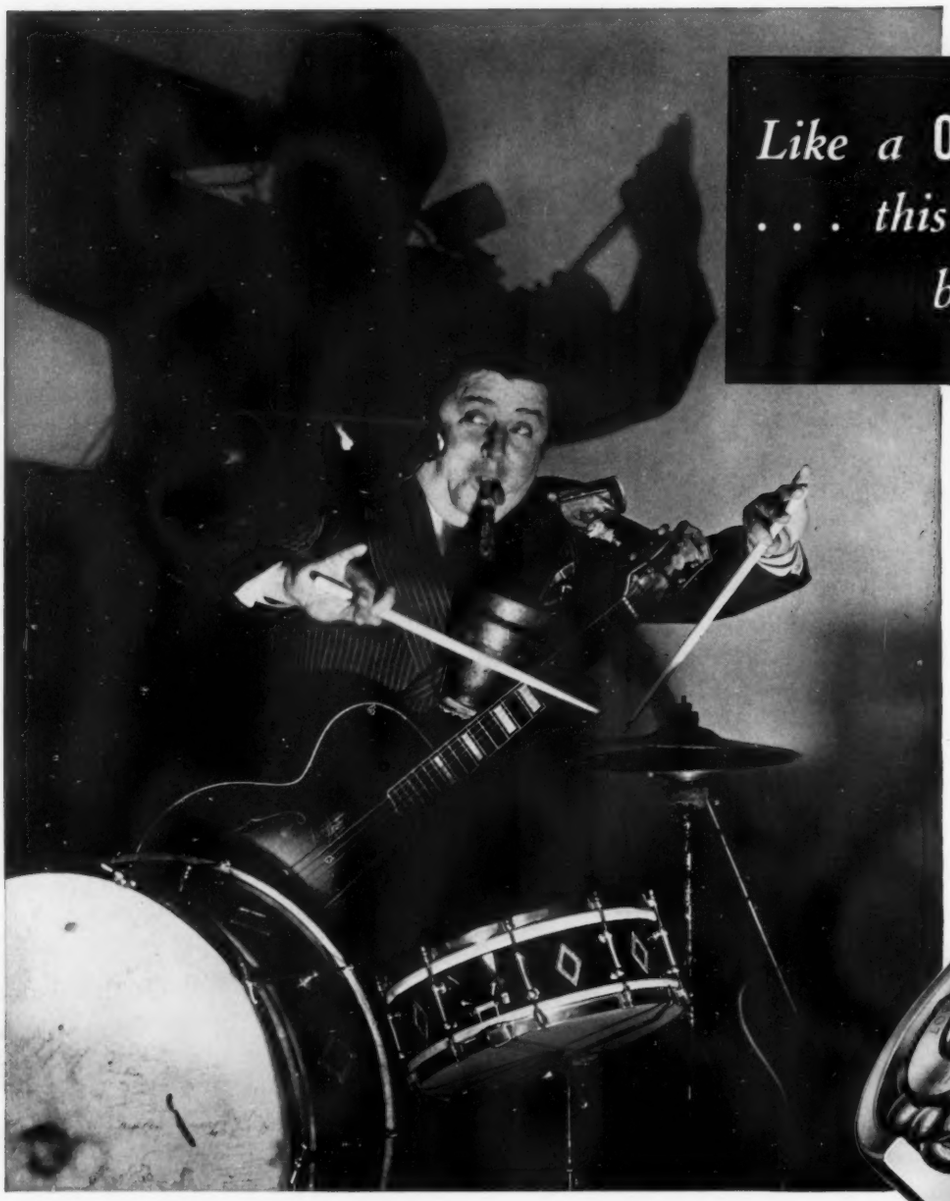
AMERICAN MACHINIST REFERENCE BOOK SHEET

Standards of Accuracy for Engine Lathes—II

Courtesy of the National Machine Tool Builders' Association

The following concludes (Part I—*AM.* Vol. 84, page 987) standards of accuracy drawn up and adopted by the builders of engine lathes, members of the National Machine Tool Builders' Association. The standards give tolerances to which the industry is building toolroom and engine lathes, and tests for tolerances.

TEST	RECOMMENDED STANDARDS		
	Toolroom lathes	12 to 18 in. engine lathes	20 to 36 in. engine lathes
 *Tailstock taper alignment, vertical*	High at end of 12-in. test bar, 0 to 0.0005 in.	High at end of 12-in. test bar, 0 to 0.0008 in.	High at end of 12-in. test bar, 0 to 0.0015 in.
 *Vertical alignment of headstock and tailstock centers*	High at tailstock, 0 to 0.0008 in.	High at tailstock, 0 to 0.001 in.	High at tailstock, 0 to 0.0015 in.
 *Lead screw alignment — readings for base length bed taken with lead screw stationary. Add 0.001 in. for each additional 4 ft. of bed length*	Parallel with ways; 0 to 0.004 in. horizontal; 0 to 0.004 in. vertical; alignment at half nut, horizontal or vertical, 0 to 0.006 in.	Parallel with ways; 0 to 0.004 in. horizontal; 0 to 0.004 in. vertical; alignment at half nut, horizontal or vertical, 0 to 0.006 in.	Parallel with ways; 0 to 0.006 in. horizontal; 0 to 0.006 in. vertical; alignment at half nut, horizontal or vertical, 0 to 0.008 in.
 *Lead screw cam action*	Maximum, 0.0003 in.	Maximum, 0.0004 in.	Maximum, 0.0005 in.
 *Cross-slide alignment*	To face hollow or concave only on 12 in. diameter, 0 to 0.0005 in.	To face hollow or concave only on 12 in. diameter, 0 to 0.001 in.	To face hollow or concave only on 12 in. diameter, 0 to 0.001 in.
Backlash on crossfeed:			
Screw	0.004 in.	0.004 in.	0.005 in.
On compound-rest screw	0.004 in.	0.004 in.	0.005 in.



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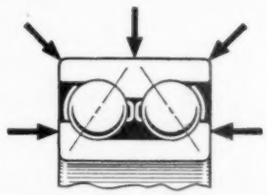

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Big advantages in economy of manufacture and machine performance result from the use of the Angular Contact Double Row ball bearing *which was originated by New Departure* to resist both radial and thrust loads.

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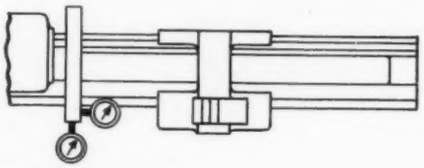
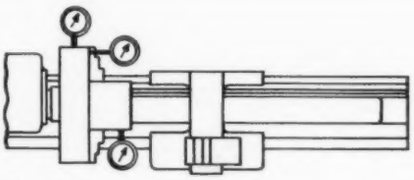
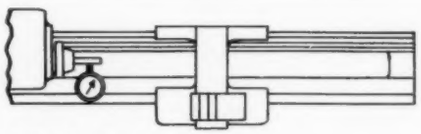
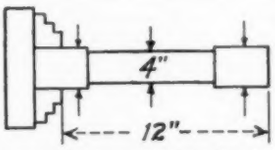
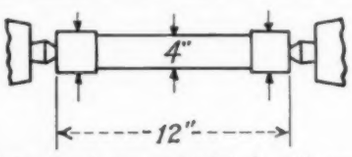
AMERICAN MACHINIST REFERENCE BOOK SHEET

Standards of Accuracy for Engine Lathes—II

TEST	RECOMMENDED STANDARDS		
	Toolroom lathes	12 to 18 in. engine lathes	20 to 36 in. engine lathes
 *Face plate run-out*	On diameter, 0 to 0.0005 in.; on face at nominal diameter, 0 to 0.001 in.	On diameter, 0 to 0.001 in.; on face at nominal diameter, 0 to 0.0015 in.	On diameter, 0 to 0.0015 in.; on face at nominal diameter, 0 to 0.002 in.
 *Chuck run-out*	Face and periphery, 0.003 in.; face of steps, 0.003 in.; bar test 3 in. from end of jaw, bar diameter same as hole, 0.003 in.	Face and periphery, 0.003 in.; face of steps, 0.003 in.; bar test 3 in. from end of jaw, bar diameter same as hole, 0.003 in.	Face and periphery, 0.004 in.; face of steps, 0.004 in.; bar test 3 in. from end of jaw, bar diameter same as hole, 0.004 in.
 *Collet chuck run-out*	1 in. from spindle, 0 to 0.001 in.	1 in. from spindle, 0 to 0.001 in.	1 in. from spindle, 0 to 0.001 in.
Lathe must turn round with work mounted in chuck	0.0003 in.	0.0004 in.	0.0008 in.
 *Lathe must turn cylindrical with work mounted in chuck*	0.0008 in.	0.0015 in.	0.002 in.
 *Lathe must turn cylindrical with work mounted between centers*	0.0004 in.	0.0008 in.	0.001 in.
Lead screw:			
Lead per foot	±0.001 in.	±0.0015 in.	±0.002 in.
Lead in any 4 in.	±0.0004 in.	±0.0005 in.	±0.0007 in.

This workman is using a 5/16–24 "G.T.D. Greenfield" Ground Thread Tap—turning it with a "G.T.D. Greenfield" Tap Wrench, and testing the hole with a "G.T.D. Greenfield" Plug Thread Gage.

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This looks like aluminum—actually it's chrome molybdenum steel, No. 4S23, tensile strength, 180,000 lbs. It's an elbow assembly for aeroplane landing gears and production conditions require a hand operation with precision ground thread taps. We are told that production is only 60 holes per tap, and taps have to be sharpened after every 10 holes. Pretty low? Well, before "GTD Greenfield" taps were used the production was only 35 holes per tap with 6 holes between grinds.

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Put All Idle Machines To Work

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An important part of that problem is to get increased machining capacity in the munitions and aircraft industries. Suddenly the demand for machine tools has descended like an avalanche in devastating fashion.

To meet the immediate situation, ingenuity must be used. Machine tool builders are doing magnificent work in shouldering a staggering load. Their story has already been told in these columns. But it would be unfair to the defense program and harmful to the nation's interests if every defense contractor sat back and waited for new tools before he began operations.

Fortunately, most companies are not doing that. They are resorting to the process of farming out work to achieve results in a hurry. In that way they bring into use idle or partially employed machinery in non-essential industries, spread production and work and payrolls more evenly throughout the country, and push ahead the entire program.

Still other avenues for quickening the armament production pace are open.

Every shop man knows that there is more than one way of doing every machining job. You may have your heart set on that battery of new XYZ machines. That's no reason, though, why you shouldn't shift the work over onto some old ABC machines until you can get what you want. Better a makeshift which will turn out 70 per cent of your anticipated quota than no production at all.

Another point somewhat along the same line: by all means let's put to work every available machine to do the enormous job just ahead. If you have any idle machinery in your plant, we suggest that you survey the possibilities ahead to see whether you will be using it in the next five or six months. If not, you can be of great service by releasing such equipment to those who are engaged in defense manufacture.

Much machinery, though it has seen considerable service, can be rebuilt or retooled for a defense job with a minimum of delay. Plants which can competently put those machines rapidly into shape for the new tasks exist in this country.

A further word. If your machine shop is not running full, you can be of valuable assistance to the government by seeking a sub-contract in connection with defense work.

It is just as vital to our defense today to put back to work all the idle machines as all the idle men. Not until that is done can we say that the armament program is operating at the highest degree of efficiency.

Burnham Finney

GAGING BUSINESS

Metal-working operations expanding as sub-contracting takes up slack capacity. Available used machinery reported scarce. British and Canadian machine tool orders total $100,000,000.

Employment and payrolls in the metal-working field are rapidly expanding in almost all parts of the country as the sub-contracting of defense work takes up whatever slack exists in the nation's thousands of machine shops. Idle machines as well as idle men are now being employed at the task of speeding up the armament program.

Machine Tools—Incoming orders continue in tremendous proportions, though in many cases the volume in November was less than in October. Bookings, however, still are greater than production, despite recent extensive expansion of plant capacity and of output. The industry's backlog is now in the neighborhood of $400,000,000. Operations today are at a rate close to $500,000,000 a year. Even with long deliveries prevailing, the industry is estimated to be in a position to take over $50,000,000 of business for shipment prior to next August 1. British and Canadian orders on hand in this country are just under $100,000,000. If defense requirements are known in advance so that production scheduling can be done to the best advantage, machine tool builders will be able to turn out $650,000,000 of machines in 1941. Good used machinery available for sale is reported scarce. Companies with machines which they do not expect to use for many months, if at all, are being urged to release them to be rebuilt for companies with munitions contracts.

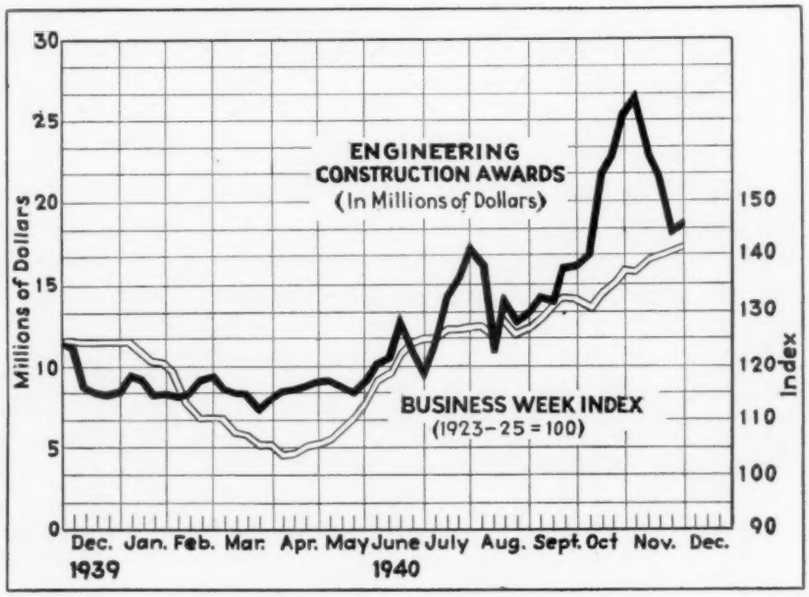
Munitions—Less than half of the $850,000,000 available to the War Department for government-financed munitions plants has been contracted for. At least $50,000,000 in additional contracts are looked for soon. Only one heavy gun factory has thus far been officially decided upon. Lack of skilled personnel to design, build and operate the proposed munitions plants is reported the main factor holding up progress. Increased size of plants, thereby reducing the total number required, has only partially solved the problem. Westinghouse is to make gun mounts and big guns for the Navy at a new factory to be built near Louisville, Ky. Lima Locomotive Works, Lima Ohio, will manufacture gun carriages in a new plant. The War Department has placed contracts for $9,956,000 of artillery material with the Koppers Co., Pittsburgh. Awards for ammunition components have totaled $8,546,179 of which $4,231,240 will be furnished by the Scoville Mfg. Co. Otis Elevator Co. will turn out $2,722,679 of artillery material at its large plant located in Yonkers, N. Y.

Aviation—Unfilled orders for airplanes and engines are close to $3,500,000,000. Deliveries of planes this year will amount to $625,000,000, against $225,000,000 in 1939. Today the industry has 164,000 shop employees; the number will be increased to 382,000 six months from now (not counting in sub-contractors). In the last 12 months aircraft makers have spent $83,000,000 for plant expansion and have let contracts for an additional $232,000,000 to be ready next June. Buick and Studebaker are both said to be preparing to make airplane engines. The grandiose scheme for producing huge quantities of plane parts in the automotive industry is still mostly in the "talk" stage.

Railway Equipment—November orders for about 8,000 freight cars and 35 locomotives will raise the year's total to approximately 56,000 cars and 425 locomotives. That volume is well above any year since 1929 with the exception of 1936. Meanwhile railway equipment suppliers are deep in defense activities. American Car & Foundry, to cite a single example, has a backlog of $115,611,801 of which $93,000,000 is for munitions products for the United States and Great Britain.

Farm Equipment—Manufacture of tractors and farm implements for the spring season is starting. The National Communal Farm Credit Bank of Mexico has contracted for $104,250 of tractors and other equipment from Minneapolis-Moline Power Implement Co.

Steel—Major expansion programs announced by Bethlehem and Tennessee Coal, Iron & Railroad are believed to be the forerunner of similar action by other steel companies. A. M. Byers will begin production within six months of a broad line of alloy steels, including stainless. American Rolling Mill and Yougstown Sheet & Tube are inaugurating mill enlargement or modernization operations. Much of the construction is an answer to the Defense Commission's and the Administration's pleas for greater ingot capacity to meet demands not only for armament, but also for non-munitions products. Now at 97 per cent, the industry is expected to produce close to 70,000,000 tons of ingots this year.



Plan to Band Together Smallest Industries for Defense Work

WASHINGTON—While Donald Nelson's small business activities committee is setting up machinery to give financing and advice to smaller firms that want defense contracts, Commissioner Hillman has given Morris L. Cooke the job of pushing down even farther into industry to reach the firm that has only a few machine tools, a little unused capacity, a few extra men, particularly in the "ghost towns" that have been left stranded by migration of industry. The plan is to get these firms in each community to band together into an organization which can pool facilities and handle a substantial volume of parts manufacture. Cooke's committee, a promotional outfit, has made sampling surveys of available facilities, is pushing formation of community groups (about six so far), and will soon circulate specimen blueprints of the sort of parts likely to be needed. Actual negotiation of contracts, of course, will lie with the prime contractors and the local councils, but Cooke is trying to maintain liaison. First major application of the plan will be in the pending expansion of shipyard facilities. Prime motive is solely to give the defense program the greatest influence on unemployment and to minimize concentration of war industries into big centers.

Machine Tool Builders Expand Plant Capacity Sharply to Meet Defense and British Needs

CLEVELAND—Within one year from the day England and Germany went to war the machine tool industry of the United States had doubled its production, and in 1941 output will reach $600,000,000, says a statement of the National Machine Tool Builders' Association. The statement is based on a survey participated in by 115 companies comprising 80 per cent of the industry's capacity.

The survey reveals that the defense burden is not falling equally on all plants. Certain types of machines are in great demand, out of all proportion to the normal needs of industry, and it is these plants which have increased their physical capacity as well as their man-hours. Of the 115 companies, 65 reported additions to factories since September, 1939. Those additions represent 30 per cent of existing manufacturing area. And the process of expansion is continuing. In some cases space hitherto unused or devoted to less important work, or to storage, has been quickly adapted to machine tool production.

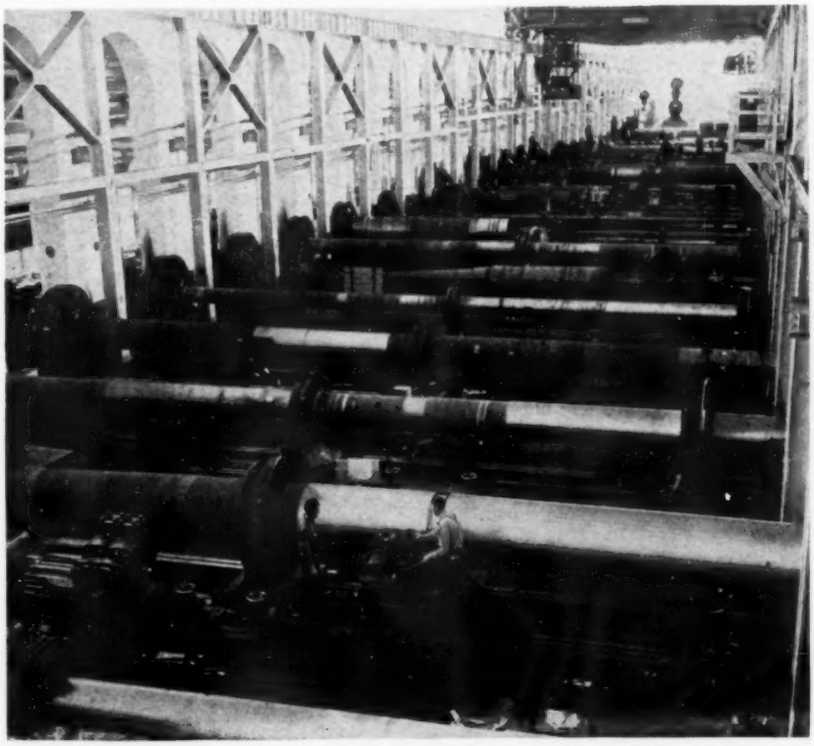
Total new equipment installed by the industry since the start of the defense program is estimated at more than $30,000,000. The industry's employment is put at about 80,000 men. Increased productivity has been accomplished chiefly by maximum use of existing and of newly installed equipment through a remarkable program of employment and training of men. Two years ago the industry employed less than 40,000. The startling fact is that almost half of the nation's machine tool employees today have been trained on the job since September, 1939. Common to most of the training programs are these features: (1) short-term learners' training is carefully distinguished from long-term apprentice training; (2) there is widespread cooperation with trade schools and vocational high schools; and (3) actual training is done *on the plant floor*.

Increased machine tool productivity also has been secured by sub-contracting work. Of 115 companies surveyed, 86 reported sub-contracting in some form. Eighty are sub-contracting parts, 33 sub-assemblies, and 23 whole machines. This procedure gives employment to hundreds of plants and thousands of men not engaged in essential work and increases output without creating new problems of housing and of investment.

New Lathe Developed

To meet the special needs of defense contractors the machine tool industry has been designing and developing much special equipment and tooling, according to the survey. One company has developed a new lathe for simultaneous turning and boring of anti-aircraft guns in advance of any order or commitment from the government. Another company has developed machines for use in the manufacture of tank clutches and has furnished the government complete engineering drawings and specifications covering clutches for three tanks. A third firm has designed special machinery for production of mechanical time fuses. Still another company has developed primarily for ordnance manufacture special long bore honing tools for gun bores and for recoil and recuperator cylinders. One builder has designed new types of gearing for optical instruments used in connection with gunfire control, searchlights and transport work.

In addition to many projects such as those outlined, several machine tool companies loaned designers to the association office to prepare for the Ordnance Department of the U. S. Army complete working drawings for two lines of single-purpose shell-making machines. These drawings are now the property of the government. They enable the Ordnance Department in time of emergency to secure large numbers of machines in a short time built in metal-working plants not otherwise engaged in essential



Guns For U. S. Defense—*Rate of production has been increased in many U. S. arsenals which are building big guns for defense. At Watervliet Arsenal (above) workers are busy turning and boring major calibre guns*

TOOL WORK DISTRIBUTION

CLEVELAND—Almost all work now being done by the machine tool industry is for defense purposes or for the British. Typical of order books is that of one company which on October 14 had the following business in hand:

	Per Cent
England	16.9
Canada	11.6
Other British Dominions	.21
U. S. Navy	6.4
U. S. Army	3.3
U. S. Air Corps	3.7
Aviation Mfrs.	25.1
National Defense Contractors	27.0
Machine tool builders	2.2
Miscellaneous	3.3

work. The first machines of these designs have been built and tested with excellent results (by Studebaker Corp. and Harris-Seybold-Potter Co.).

The survey, which stated that production this year will exceed $400,000,000, was made to obtain more detailed information as to ways and means whereby increased output has been accomplished, the relationship between machine tools and national defense, and the nature and extent of the industry's cooperation with the government and with manufacturers of defense equipment in helping to solve the technical problems involved.

Aircraft Research Plant Seen As Small Effect on Armament

WASHINGTON—Aircraft engine research by the National Advisory Committee's laboratory to be built at Cleveland can have little effect on the present armament program. Some phases of the $8,400,000 engine plant will be completed within a year, but its full effect cannot be realized for two or three years.

The laboratory has six major units: Power plant; power plant wind tunnel; engine torque stand; fuels, lubricants and instruments; hangar and adminstration. During the past ten years the power output of airplane engines has been doubled without increasing the weight. NACA wants to continue this reduction. Among other aircraft power plant improvements wanted: Harness exhaust gas to aid plane propulsion; improve supercharging for wide range of altitudes; improve fuels to increase horsepower; find alloys to withstand additional stresses; advance the diesel engine for air use; work out a gasoline fuel injection system; prevent carburetor ice; advance the direct gas propulsion principle or "rocket" plane; and improve constant-speed and feathering characteristics of propellers.

Effect of Armament Program and Post-War Adjustment Plans Feature A.S.M.E. Meeting

NEW YORK—A proposal to set up immediately a board of planning and research through which industries expanded beyond normal may be regeared to produce a higher standard of living during peace time was made to the American Society of Mechanical Engineers at its annual meeting. It was advanced by William L. Batt, aid to Edward R. Stettinius, Jr., member of the National Defense Advisory Council in charge of the Industrial Materials Division. According to Mr. Batt, such a plan would determine what to do with the excess manufacturing capacity which we are creating as a result of our armament program, where to find jobs for the men we are training for the production of wartime material, who is to own and operate the plants the government is building or subsidizing, and what to do about the federal debt incurred by necessarily huge expenditures for defense.

Mr. Batt's proposal was the highlight of an annual meeting attended by 5,000 engineers and executives. Included in the program were 100 technical papers presented at 50 separate sessions of various divisions and research committees of the Society. Many of the papers were devoted to phases of the National Defense Program.

R. F. Gagg, assistant chief engineer, Wright Aeronautical Corp., stated that when plans now under way are completed the combined output of American aircraft engine builders will be fifteen times their capacity during the summer of 1939. This will be accomplished, according to Mr. Gagg, with no sacrifice in the technical performance and durability of the product. The plans call for cooperation between the automobile, aircraft and machine-tool industries, and in this regard the results have already been gratifying. Combined efforts of these groups, and also of technicians, supervisors and workers in all the industries involved, will enable the engine builders to reach production peaks when the plans are consummated.

William A. Hanley, right, inducted as A.S.M.E. president at the Society's annual dinner December 4, is greeted by retiring president W. H. McBryde as secretary C. E. Davies looks on

Edward A. Muller, president, King Machine Tool Company is apparently enjoying the circus which was an entertainment feature at the annual A.S.M.E. meeting at Hotel Astor

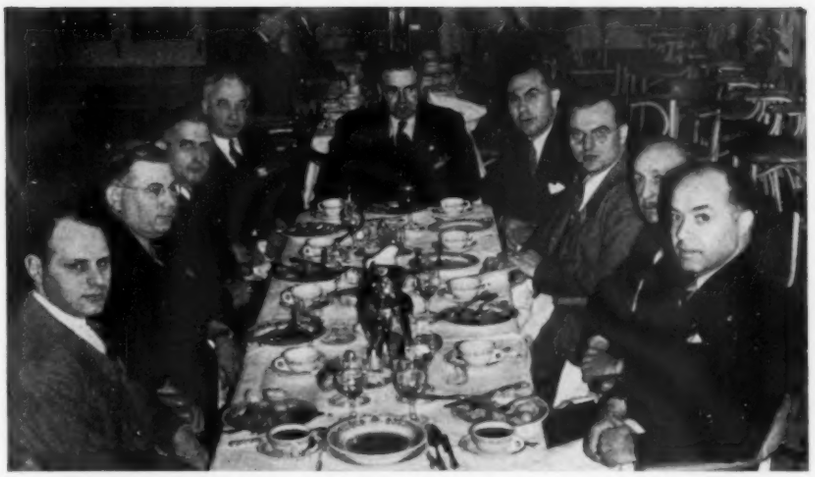
Many of the papers revealed the industrial gains to be expected from efforts in the armament program. Albert B. Cudebec, British engineer, stated stainless steel, nickel alloys and other materials of both ferrous and nonferrous types that do not work well after rolling or welding are now being shaped faster and more economically by extrusion presses. He said the development will make possible the substitution of special alloys for heavier metals. Although devised primarily for improvement in aircraft design, Mr. Cudebec stated its application to peace-time products will probably create another large industry in this country.

Ross Cunn of the Naval Research Laboratory, Washington, D. C., described equipment of recent design for detecting surface and submerged flaws in non-magnetic material. Such detection is done by establishing a pre-

determined pattern of electrical eddy currents in a perfect test sample of the material to be tested, and checking the results against eddy currents in parts in production.

The shortage of engineers, technicians and skilled workers was reviewed for the engineers by Dean A. A. Potter of Purdue University. He stated the 165 U. S. institutions offering instruction leading to engineering degrees can be utilized to promote training of these men by (1) holding classes for groups in industrial areas where many students can gather to avail themselves of educational equipment, (2) promoting extension courses by colleges in sparsely populated sections of the country, and (3) intensifying resident programs of study varying in duration from one to eight months. Legislation is now pending before Congress which will provide a fund to facilitate such training.

Among many lubrication problems discussed at the meeting were those encountered due to new materials in machine construction, including plastics, monel metal, stainless steel, and lead-copper and cadmium-silver alloys. V. I. Palmer of Eastman Kodak Company states a sound-recording apparatus had been developed to detect bearing failures. It is based on the principle that bearing wear is accompanied by increase in running temperatures which induce sound changes characteristic of imminent failure.



The committees on cutting fluids and cutting of metals meet at lunch. Left to right—F. J. Schmitt and W. H. Oldacre, D. A. Stuart Oil Company; L. N. Gulick, University of Pennsylvania; C. B. LePage, assistant secretary, A.S.M.E.; Malcom F. Judkins, Firth-Sterling Steel Company; O. W. Boston, University of Michigan; H. L. Moir and R. F. Overlock, The Pure Oil Company; and Dr. M. E. Martellotti, Cincinnati Milling Machine Company

Machine line production of aircraft materials was discussed by P. R. Bassett of Sperry Gyroscope Company, Inc. Like many companies involved in rapid expansion, Mr. Bassett reported that the Sperry company, rather than expand haphazardly, sub-contracted 140,000 work hours, tried to keep a constant ratio of Sperry machine-hours to sub-contracted machine-hours, and proceed in an orderly fashion in getting the right machines and properly trained personnel for its own plants. Thus, the sub-contractors act as a cushion for the rapid acceleration in production.

At the annual Dinner and Honors Night of the Society's meeting, Charles F. Kettering, vice-president and director of General Motors Corporation, received the A.S.M.E. medal for his influence on automobile development. It is the highest award given by the society. The Melville medal was presented to Carl A. W. Brandt for his achievements in railway mechanical engineering. Following the presentation of these medals, and other awards, William A. Hanley of Eli Lilly Company, Indianapolis, Ind., was inducted as new president of A.S.M.E.

Left—F. O. Hoagland, vice-president, Pratt & Whitney Division, Niles-Bement-Pond Company, and Warner Seeler, secretary, Warner & Swasey Company discuss matters at the Machine Shop Practice Division Meeting. Center—Sol Einstein, vice-president, Cincinnati Milling Machine Company, and A. M. Johnson, president, Barnes Drill Company watch the circus at the annual smoker. Right—Francis Trecker, sales engineer, and J. B. Armitage, engineering director, Kearney & Trecker Corporation, at the Machine Shop Practice Division Meeting

Rapid Expansion of Australian Machine Tool Manufacture Aided by Curtailed Imports

MELBOURNE—Australia's latest and most vital war industry, the manufacture of machine tools, is expanding rapidly. The Commonwealth Government has ordered tools valued at $6,500,000 from 28 engineering firms. Machines and tools are now being produced which only a year ago were thought beyond Australia's capacity.

When the war came, one Australian firm was manufacturing lathes, and two firms made power-presses. The commonwealth depended primarily on machines imported from the United Kingdom, Germany, and the U. S. The war cut off the German supplies, and it was not long before the United Kingdom and the U. S., experiencing a shortage of machine tools, restricted exports.

The Commonwealth Government decided to initiate an ambitious program of machine tool making. Thousands of tools, jigs, and gauges were ordered from Australian firms. One which did not exist a year ago now makes substitutes for 24 German cartridge machines, and with half a dozen other firms is producing a total of 700 of these machines.

Make Power Presses

Huge power-presses with capacities between 700 and 5,000 tons are being made. Also engine lathes capable of turing 30 foot lengths, 24 inch diameter gun lathes for turning, boring and riveting up to 20 feet in length, capstan turret lathes of various lengths, and shell lathes up to six inches in diameter. Sundry types of drilling, milling and shaping machines, large-capacity grinding machines, hacksaws, cold-saws and similar tools are also produced.

A factory now being equipped in Sidney for the manufacture of optical glass will be equipped entirely with Australian machinery. Other Empire countries have ordered Australian machines.

Establishment of an optical glass industry designed to supply service requirements has been entrusted to Australian Consolidated Industries Ltd., which will produce such precision instruments as artillery range-finders, anti-aircraft gun predictors, telescopes, and binoculars. Although optical glass has not been made in Australia previously, New South Wales has ample modern equipment for the manufacture of sheet glass and ornamental cut glass, and therefore has many experienced operators available. Previously spectacle lenses required in Australia were ground from imported optical glass. Firms doing this work will help in training additional craftsmen required.

Among other new industries shortly to be established will be one at Newcastle, New South Wales, making stainless steel, which will obviate shortage of surgical instruments. In Melbourne a factory will shortly be producing aviation spark-plugs, one of the few remaining airplane components still not manufactured in Australia. The factory's output will be usable by American types of planes, such as the Douglas, Lockheed Hudson, and Wirraway, now widely used in Australia.

Canada Rushes Plans For Larger Shipbuilding Program; Yards Active

MONTREAL — Canada is rushing plans for the development of shipbuilding on a much larger scale than heretofore. To insure "full speed ahead" the government has appointed a shipbuilding controller who will have unlimited powers in requisitioning materials, supplies, etc.

Present shipyards, some 16 on the coasts and 25 lesser yards working on smaller craft, have enough orders to keep busy for another year. To date 200 small war vessels, including boats used on inland waters, have been delivered. Recently contracts have been awarded for 10 diesel-driven minesweepers, 18 large cargo ships. Further orders for cargo ships are expected momentarily.

Arrangements have been made for the production of the following types of guns: .40mm Bofors anti-aircraft; 2.7 anti-aircraft; 25-pounder guns and carriages; Colt-Browning aircraft machine guns and tank machine guns; six and 2-pounder guns for tanks; four and 6-inch naval guns; and Lee Enfield rifles.

One of the biggest problems to be solved, if the government's schedule to produce $1,500,000,000 of munitions annually is to be adhered to, is that of labor. Since a conciliation board jumped wages 17 per cent at the John Inglis Co., Bren gun makers, wage troubles have increased in all plants engaged in war work. Government schools for training young men for war industries are being expanded. At present 28,000 men are enrolled.

Subscriptions Held in Abeyance For Those in Military Training

NEW YORK — All subscribers to AMERICAN MACHINIST who are called to service in the armed forces of the U. S. will, on application, receive "letters of credit" if they desire to cancel their subscription of the magazine. The "letter of credit" will enable a subscriber to resume his subscription when his period of training is over.

SHIPS FOR ENGLAND

WASHINGTON—A deal, yet to be consummated, under which upward to 360 cargo ships will be built in the U. S. for British needs has been long delayed. However, in Britain's dilemma the U. S. sees an opportunity. The U. S. wants to build the ships and sail them in the service of England around Africa and on other "neutral" routes, but under the American flag. This would relieve England's far-flung shipping for concentration on trans-Atlantic service which is forbidden to U. S. ships because of the combat zone. This scheme would serve England just as well right now, but after the war the U. S. would have a set-up to muscle in on the Empire's trade. Predictions are that the U. S. will have its way. Nevertheless, the ships will be built. They will probably be in the 10,000- to 12,000-ton class. Further, a way may be found to release some of the C-type ships now being built by the Maritime Commission.

Air Conditioning Allows Control Of the Quality of Iron Produced

PITTSBURGH—Jones & Laughlin Steel Corp. has installed air-conditioning equipment capable of removing from seven to forty tons of water per day from the air blown into its No. 1 blast furnace at the Aliquippa Works. The installation will enable a closer control of the quality of iron produced.

This is the first modern air-conditioning unit to be installed in the North for conditioning air blown into a blast furnace. The equipment will be used to maintain a constant low moisture content in the air blast, eliminating the necessity of trying to out-guess the weather 24 hours in advance of charging the furnace. Ordinarily, wide fluctuations in humidity cause irregular blast furnace operation, which results in a smaller aggregate iron production.

Nazi Shortage of Skilled Labor Sees Use of Automatic Machinery

WASHINGTON — A shortage of skilled labor is forcing Germany's machinery industry to adopt automatic or semi-automatic machinery to an extent hitherto unknown in the Reich. The scarcity of raw material supplies and of foreign exchange has taught the industry to employ metal-saving construction methods wherever possible. This has led to an extensive use of welded instead of cast machinery parts, to substantial reductions in the dead weight of machinery.

INSIDE DETROIT

Auto sales records may continue to fall like tenpins throughout the 1941 model year. Used car inventories are high, but the turnover averages 30 days; shortages, however are forecast by Spring.

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Fat pay checks for auto workers and humming factories look like a sure thing for the entire winter. Local sources report that some plants will continue overtime work in December, and that tentative schedules for January and February are set so high that long hours are in prospect for those two months. Of course, not all producers are in such fortunate circumstances, but the five-day week with full crews may be accepted as the general situation of the industry during a period when seasonal influences have drastically cut production in the past.

Underlying these bright predictions is the word that parts plants have not been asked to pare schedules in the weeks ahead. Suppliers are ordinarily informed of their commitments for two to three months in advance. So far, the auto plants are still calling for all the parts that they can get. This condition may spring from either of two motives (1) anticipation of sustained heavy retail demand or (2) a fear of priorities in the spring. The first reason probably fits the case, because facilities are not available to store the flood of parts, nor is it desirable to over-supply dealers. The priority question is a bridge that hasn't been reached yet.

Buick Makes 1700 Cars Daily

Buick has attained a production rate of 1700 cars daily, and this rate will be unchanged through February, and possibly March. Schedules for the first quarter of 1941, if achieved, will top the 1940 period by around 25 per cent.

The operations of this G.M. division are more spectacular than most other producers, but it must be remembered that Buick was the bellwether of the industry during the 1940-model year. Before the present season started, the Flint concern expected a 10-15 per cent gain in production over the Oct.-Dec. period of 1939. Actually domestic demand is up 20 per cent. October retail deliveries reached 33,500 units, up 30 per cent, November sales will probably total 32,000, up 10 per cent, and December is expected to produce more than 31,000 sales, or 20 per cent ahead of last year.

A recovery of moderate proportions plus the superimposed national defense program are likely to bring about a retail sales situation whereby most, if not all, of the remaining months in the model year will establish new sales records. Reactions to events abroad are likely to prove only temporary, and decreased purchasing power through national-defense levies and higher living costs are not viewed as factors which will affect domestic demand during the balance of the 1941 run.

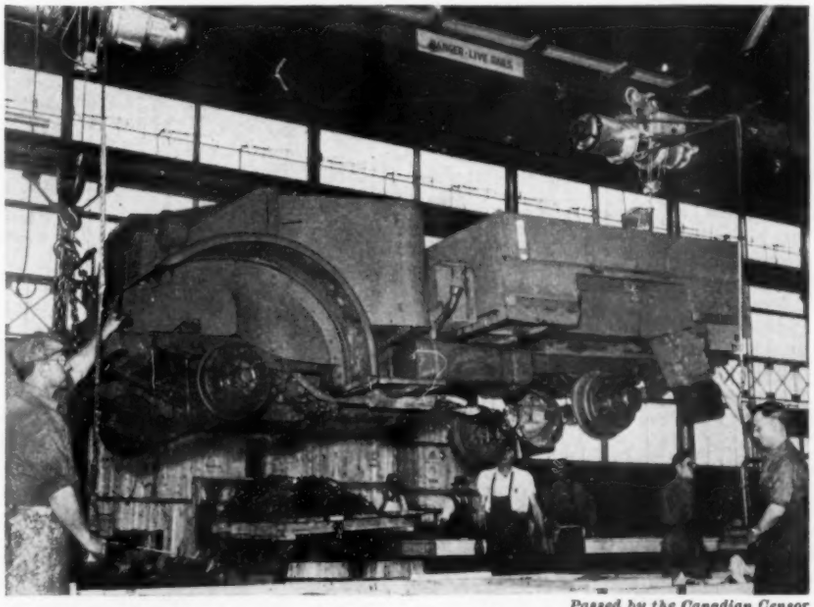
Used-car inventories are high, but the turnover averages 30 days, a very satisfactory figure at this time of year. Sales are keeping pace with trade-ins, a scarcity of used cars is forecast in the spring because national defense is creating new employment and adding working hours.

These opinions are shared by other producers, although they may not be quite so optimistic. Retail sales by the industry in November set a record, but the total was not quite equal to the October record because of holidays and bad weather. Large producers like Chevrolet can hardly be expected to make such spectacular gains as some of the independents and plants serving the medium-price field. Yet it is production of such plants as Chevrolet, Ford and Plymouth that is swelling monthly totals to near the 500,000 mark. Chevrolet produced its 300,000 current model on Nov. 27. Since the first of the 1941 units left the assembly line on Sept. 23, Chevrolet chalked up three-tenths of a million cars in just 62 working days.

Pontiac worked six-day weeks in November. The last week of the month saw production of 8,376 cars, the highest weekly total since 1928. Dealer stocks are reaching the leveling off point, so it may not be

ARMY TRUCK ORDERS

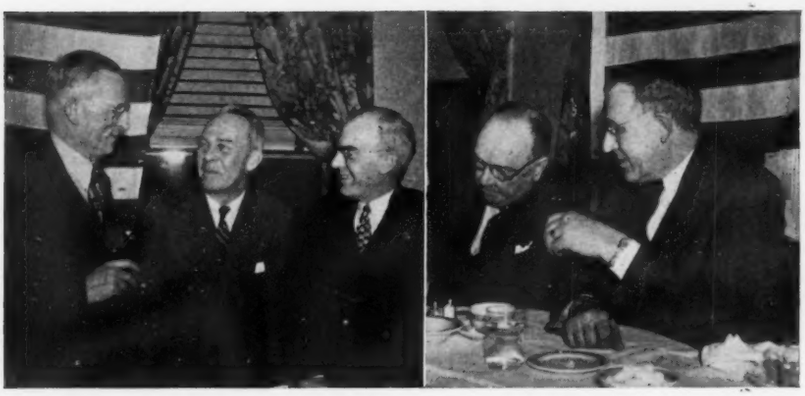
DETROIT — Government purchases of Army trucks are expected to take a bound upward in the near future. General Motors divisions are quite likely to get the lion's share. Corporation officials refuse to divulge information in advance of a public announcement from Washington, but it is known on good authority that Chevrolet's participation in the business will probably dwarf contracts already awarded. Yellow Truck & Coach is building an undisclosed number of trucks, about which the Army and G.M. have kept quiet. That division may also get further orders. It has already taken steps to double output on certain operations.



Passed by the Canadian Censor

On To England—*The Ford Motor Co. of Canada is making five sizes of all-purpose trucks for the British Army, including four-wheel drive types. Upon completion of satisfactory tests, running wheels and gear are removed and the truck is boxed for export*

Production for National Defense Discussed at Hartford A.S.T.E. Meeting



Tool Engineers Meet—*More than 200 members and guests attended the December 2 meeting of the Hartford Chapter of A.S.T.E. to hear Lt. Col. E. M. Ayer, Hartford Ordnance District, U. S. Army, and Clayton R. Burt, chairman, N.M.T.B.A. National Defense Committee, discuss production problems involved in the current defense program. Among the guests present were, left to right, Col. F. H. Payne, district chief, Hartford Ordnance District; Herbert H. Pease, president, New Britain Machine Co.; H. D. Tanner, vice-president, and Clayton R. Burt, president, Pratt & Whitney Division Niles-Bement-Pond Co.; and F. G. Hughes, president, New Departure Division, General Motors Corporation*

Guests—*Also present at the Hartford A.S.T.E. meeting on national defense were S. M. Stone, president, Colt's Patent Fire Arms Manufacturing Company, and H. M. Toppin, president, Jacobs Manufacturing Co. Arrangements for the meeting were made by Frederick L. Woodcock and Louis E. Eberts of Hartford*

necessary to continue overtime.

In the fine-car field, Cadillac had to go to the nine-hour day. Unshipped orders at the end of first twenty-day selling period of November stood at 11,774 units, an all-time high. The reason for overtime is apparent, when it is known that retail deliveries of 3,295 units set a new record for the period.

Hudson domestic shipments of 1941 models, for the first four months of the current selling season, already exceed one-half the volume of cars shipped in the entire 1940 season. In common with other makers, Hudson reports that West Coast cities such as Los Angeles, Portland and Seattle, are approximately 70 per cent ahead in sales as compared with last year, because of local national defense activities there.

Aircraft Engines

By this time it is expected that negotiations between Buick and the government will have been completed for manufacture of twin-row Pratt & Whitney engines at Flint. Company sources refuse to state which twin-row model will be built, how large a plant will be required, and how many engines are involved until an official announcement by the National Defense Commission. Suppliers, who logically might figure on equipment involved, have not been drawn into the picture so far.

Local sources are skeptical that Ford can get going on its Pratt & Whitney engine program until some time next fall because of the equipment-delivery situation. Packard has been buying machinery for installation in parts-suppliers' plants, since a number of items on the Rolls-Royce engine will be farmed out.

Midget "command reconnaissance 4-4" Army trucks designed to replace motorcycles and sidecars will start rolling from an assembly line at the Ford Motor Company in January. These trucks are designed to hide in brush, climb out of holes impossible to a tank, and may even be suitable for transportation in the cargo holds of Army planes.

Ford got an order for 1,500 trucks to cost $1,387,500; American Bantam an order for a similar quantity. It is understood that the Ford design is slightly lower in overall height, which is desirable for concealment purposes. Height to the cowl of the Ford truck is only 38 in., and the windshield folds down to 40 in. Length is 81 in., tread 47½ in. Despite the small size, the truck will carry a three-man crew, an all-angle machine gun to repel air attack and a sub-machine gun. If necessary, the vehicle might be used for hurry-up transport of troops, although it is not designed for attack purposes.

The truck is equipped with front and rear blackout lights. Maximum speed is 60 miles per hr., 40 per hr. cross-country. Four-wheel drive in combination with a six-speed transmission provides maximum maneuverability over all sorts of terrain. Six forward and two reverse speeds are supplied by means of the transmission, which is equipped with an auxiliary speed range. A lever is supplied to cut the front wheel drive in or out as needed. The Ford design weighs about a ton, will carry in excess of 1,000 lb., and is powered by the four-cylinder tractor engine, which has been modified to supply 42 hp.

Extend Export Licensing System; Forced by Faster Defense Pace

WASHINGTON—The increased pace of the National Defense program requires the extension of the export licensing system. The following items were placed on the export control basis as of Dec. 10:

All used or rebuilt machine tools of any description; pipe threading machines; metal cutting band saws; power-driven hack saws; keyseating and disc grinding machines; car wheel and locomotive wheel presses; gear burring; chamfering, and burnishing machines; crank planers; bench power presses; saw sharpening machines; filing and pipe bending machines; thread chaser grinders; burnishing machines; tool and cutter grinders, universal and plain hand feed; riveting and grinding machines, portable with flexible shaft; and centering machines.

Grinders, face milling cutter; arbor presses (hand, air, and hydraulic); drill, tap, and hob grinding machines; nibbling machines; lathe tool grinders; gear lapping and shaving machines; polishing machines; heat treating furnaces; foundry machines; twist and other drills; reamers; milling cutters; hobs; taps; dies; die heads, and shear knives.

McGRADY APPOINTED CONSULTANT

WASHINGTON—Edward F. McGrady, former Assistant Sec. of Labor, has been appointed special consultant on labor matters to Sec. Stimson. McGrady will act as government "trouble shooter" in industrial labor disputes.

WATCHING WASHINGTON

Vultee settlement still gives no indication of government policy toward strikes which impede munitions production. Administration favors large-scale expansion of war plants over priorities

By BLAINE STUBBLEFIELD

WASHINGTON—Settlement of the Vultee strike left largely unanswered the question of what an administration which prides itself on a pro-labor attitude is going to do about strikes impeding munitions production. One thing clear is that an outright showdown will be postponed as long as possible. The Vultee strikers were subjected to strong pressure, ranging from personal appeals by administration leaders to denunciation of the strike leaders as Communists by Attorney General Jackson. However, once the strike was over, the President tried with probable success to stall off legislative proposals to outlaw munitions strikes —though holding a threat in reserve by intimating that his views on the question are not unalterable.

The settlement also indicated that the strongest weapon for informal pressure is the group of comparatively conservative labor leaders who are under the influence of the President. The deciding element at Vultee, apparently, was the calling in of R. J. Thomas of the Auto Workers, who was the organizational superior of the strikers.

The Vultee strike helped to pose the issue. But the issue was there anyway; business and government and labor have been watching it, chary as one might eye a time bomb, for months. If the Vultee incident hadn't touched it off, some other incident would. Certainly no intelligent observer thought that organized labor voluntarily would suspend its rights under the Wagner law without a struggle. It is platitudinous to point out that the wage workers are going to shoulder up to the defense gravy though along with management.

An eventual showdown seems nearly inevitable. As the production tempo increases labor is acquiring scarcity value. A considerable element of labor, now largely under Lewis leadership, is not convinced that the country is virtually at war and is therefore not very amenable to appeals that production must under no circumstances be delayed. In aircraft, particularly, the CIO has announced its intention to unionize the now largely unorganized industry and bring wage levels up to those of the auto workers.

For the next few strikes, informal mediation will be relied on. There will be pressure on labor, as at Vultee, to accept arbitration clauses. There will certainly be pressure on unorganized employers to recognize unions and probably to grant moderate wage increases.

The Government is strapped solidly in the middle. New Deal policy is to help the working man to a better living. But it is also pledged to prevent spiraling prices and a war boom. Compromise is the one way open, both in executive and legislative action. But the Willkie wing in Congress, its strength already demonstrated, will lend a mighty drive to the Administration's cost control wing, which automatically opposes labor's interest.

One should remember too, that Mr. Roosevelt himself is no longer the white hot crusader he once was. He doesn't have to be elected any more. His appointment to the Labor Board, of Dr. Millis, a conciliator, is a good indicator of his turn of mind.

When the issue gets to Congress it will be a long bitter fight. Ultimate compromise may well be a variation of the Railway Labor Act for defense industries—a compulsory waiting period, government investigation and publication of results, with theoretical preservation of the right to strike afterwards.

MORE DEFENSE FUNDS NEEDED

WASHINGTON—A new and supplementary program on national defense, which will add billions to staggering sums already appropriated, is expected to be presented to Congress early in the January session. How much money will be asked isn't yet known. It may run up to $6,000,000,000; again it may be somewhat less. Just what activities the program will cover has not yet been determined. It is likely, however, to include money for a further ship construction project and for automotive manufacture of aircraft parts. Some experts in Washington are estimating that the total defense program will cost the country's taxpayers $35,000,000,000. A while back the figure quoted was $25,000,000,000. The truth is nobody knows what the final expense will be because nobody has any idea how long the armament program will last or what its ultimate scope will be.

Britain Gets Half

President Roosevelt's statement that we are already giving Britain our maximum of equipment means the 50-50 division, not volume. Even the half-and-half deal is only for today. The farther we swim across the river with England the less point there will be in turning back. If and as British success seems more likely, both the proportion and the volume of our aid will increase. It can very well turn out to equal or exceed our production in the World War.

The 50-50 division can be maintained and still be very misleading. For example, the half of our airplane production going to Britain is nearly all combat equipment, while the half we keep is mostly training planes. This kind of discrepancy can and does apply to other forms of munitions.

Expansion vs. Priorities

If the substantial expansion of steel capacity which the administration thinks will be announced within a week or two comes through it will soothe a problem which has agitated the administration in recent weeks and split the Defense Commission. Basic issue has been the alternative of expansion or priorities. The industry, fearful of excess capacity after the war, and questioning that demand will exceed present supply, felt that expansion could be avoided by rationing civil customers if the pinch came. It was supported in this view by Stettinius' raw materials division of the defense commission. In other sections of the defense commission, including Nelson's Priorities Board and Henderson's Price Division, it was felt that if inflation is to be avoided, the supply of civil commodities must be maintained. Government economists pointed to a tightness already being felt in the supply of heavy plates and structural shapes and to a level of steel production which is already crowding capacity with defense production barely underway.

The administration finally swung to the expansion side, and pressure was exerted on the industry. The President himself is supposed to have been called in, and reportedly a threat was made that big commercial steel customers would be encouraged to produce their own steel if the industry proved obdurate.

Bethlehem Steel Expands Its Plant; Others May Follow Suit to Speed National Defense

NEW YORK—Bethlehem Steel will expand its ingot capacity 850,000 tons at a cost of $18,000,000. The new facilities will be located at the Bethlehem, Lackawanna, Maryland and Steelton plants. This comes on top of the action taken by Tennessee Coal, Iron & Railroad to increase its ingot facilities about 20 per cent. It is highly probable that other major producers will follow suit.

This steel expansion program is directly caused by the feeling on the part of members of the National Defense Advisory Commission that additional steel capacity is desirable to meet any possible needs for armament production. New Dealers, in particular, believe that the defense effort can be superimposed on the normal requirements of the country for non-defense goods and that as defense spending increases, the added purchasing power of workers will greatly stimulate sales and manufacture of such goods as radios, refrigerators, washing machines and automobiles. This development, according to administration economists, may lead to a national yearly income of eighty-five to ninety million dollars. Such expansion of activities would find present steel capacity unequal to the demand.

For many weeks the steel industry has been running at 90 to 96 per cent of theoretical capacity. This year it will turn out close to 70,000,000 tons of steel ingots, a total exceeding 1929. Much talk has been heard of the possible necessity for rationing steel through a priority system, but thus far this has not been imperative. Buyers accustomed through many depression years to getting steel deliveries almost overnight are now ordering two or three months in advance. For many months it is believed that production has considerably exceeded consumption, indicating that users have been stocking steel against a rainy day.

Not long ago Walter S. Tower, president Iron & Steel Institute, issued a statement declaring that the maximum annual defense needs for armament purposes would not be over 8,000,000 tons and that no possibility of a shortage looms. He pointed out that the industry's ingot capacity is rated at 83,000,000 net tons, which is 10 to 12 per cent below the real capacity, that margin being allowed for breakdowns and repairs of furnaces. The industry can run close to rated capacity for sustained periods and go beyond for occasional periods. In 1917, for example, it maintained full capacity for seven consecutive months.

Mr. Tower emphasized that not all elements of steel demand ever rise to peaks simultaneously, and anyway any such peak is a passing phenomenon. This is especially true of civilian demand. Deficiencies, on the other hand, may occur in certain classes of products. Alloy steels, for instance, have come to the front so fast, especially in relation to defense products, that a shortage of electric furnace melting capacity was anticipated by the industry some time ago and many companies have been installing new furnaces.

Canadians "Freeze" New Models To Aid Tool Makers in War Jobs

OTTAWA—The making of new models for automobiles, refrigerators, cooking equipment, radios, vacuum cleaners and typewriters is prohibited in Canada for the period of the war in order to enable toolmakers to concentrate upon the essential job of manufacturing jigs, dies and molds. C. G. Howe, minister of munitions and supplies, indicates that, "Existing models in current use in Canada will continue to be frozen. No change will be permitted except for good and sufficient reason and then only under permit from the machine tool controller."

U. S. Government Contracts Awarded to Metal-Working Firms

(Does not include contracts under $100,000)

Source	Agency	Commodity	Amount
Continental Motors Corp., Detroit, Mich.	War	Automotive equipment	$294,662
American Brass Co., Waterbury, Conn.	War	Small arms ammunition	180,264
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	Navy	Automatic pilots	5,044,887
United Aircraft Corp., Pratt & Whitney Aircraft Div., East Hartford, Conn.	Navy	Airplane engines	57,856,179
Gisholt Machine Co., Madison, Wis.	Navy	Turret lathes	107,397
Kearney & Trecker Corp., Milwaukee, Wis.	Navy	Milling machines	326,373
Higgins Industries, Inc., New Orleans, Pa.	Navy	Boats	2,177,500
National Forge & Ordnance Co., Irvine, Pa.	War	Forgings	139,633
Stewart-Warner Corp., Chicago, Ill.	War	Artillery ammunition components	352,227
Budd Wheel Co., Detroit, Mich.	War	" "	405,760
Smith Bros. Mfg. Co., Findlay, Ohio	War	" "	128,384
Southern States Equipment Co., Birmingham, Ala.	War	" "	440,534
Cleveland Container Co., Philadelphia, Pa.	War	" "	215,891
E. I. duPont de Nemours and Co., Carney's Point, N. J.	War	" "	233,000
Carter Carburetor Corp., St. Louis, Mo.	War	" "	259,534
Armstrong Cork Co., Pittsburgh, Pa.	War	" "	414,760
Briggs & Stratton Corp., Milwaukee, Wis.	War	" "	276,250
Blackhawk Mfg. Co., Milwaukee, Wis.	War	Jack assemblies	178,815
Mergenthaler Linotype Co., Brooklyn, N. Y.	War	Telescope mounts	1,194,710
Babcock & Wilcox Tube Co., Beaver Falls, Pa.	War	Steel tubing	274,566
National Pneumatic Co., Inc., Rahway, N. J.	War	Tubes	178,300
Standard Pressed Steel Co., Jenkintown, Pa.	War	Cores	290,190
Midvale Co., Philadelphia, Pa.	Navy	Forgings	8,121,125
Revere Copper & Brass Inc., Baltimore, Md.	War	Cartridge cups	751,666
American Brass Co., Waterbury, Conn.	War	" "	1,035,880
Bendix Aviation Corp., Eclipse Machine Division, Elmira Heights, N. Y.	War	Time fuses	10,218,000
American Locomotive Co., Schenectady, N. Y.	Navy	Turret rollers	144,978
Baldwin Locomotive Works, Standard Steel Works Div., Philadelphia, Pa.	Navy	Rollers	146,073
Cincinnati Milling Mach. & Cincinnati Grinders, Inc., Cincinnati, Ohio	Navy	Milling machines	319,431
Douglas Aircraft Co., Inc., Santa Monica, Calif.	War	Airplanes	161,549,794
Standard Steel Works, N. Kansas City, Mo.	War	Trailers	173,809
Bendix Aviation Corp., Scintilla Magneto Div., Sidney, N. Y.	War	Distributor assem.	231,503
Mergenthaler Linotype Co., Brooklyn, N. Y.	War	Quadrants	1,801,037
Gilbert & Barker Mfg. Co., W. Springfield, Mass.	War	Telescopes	1,637,723
Sperry Gyroscope Co., Inc., Brooklyn, N. Y.	War	Gun data computers	3,352,421
David White Co., Milwaukee, Wis.	Navy	Sextants	136,534
Norris Stamping & Mfg. Co., Los Angeles, Calif.	Navy	Ammunition boxes	848,812
Commercial Shearing and Stamping Co., Youngstown, Ohio	War	Brackets	126,000
Flour City Ornamental Iron Co., Minneapolis, Minn.	War	Bridge equipment	1,169,610
National Tube Co., Washington, D. C.	Navy	Bombs	206,139
Bridgeport Brass Co., Bridgeport, Conn.	War	Cartridge cases	135,000
The Buda Company, Harvey, Ill.	War	Boring machine	117,427
C. H. Gosiger Mach. Co., Dayton, Ohio	War	Lathes	218,911
Consolidated Steel Corp., Ltd., Los Angeles, Calif.	Navy	Caissons	152,000
Continental Motors Corp., Detroit, Mich.	War	Engine parts	294,662
Ford Motor Company, Dearborn, Mich.	War	Engines	122,323,020
Remington Arms Co., Inc., Illion, N. Y.	War	Shotguns	165,253
The Midvale Co., Philadelphia, Pa.	Navy	Forgings	670,000
Lansdowne Steel & Iron Co., Morton, Pa.	War	Forgings	539,760
American Brass Co., Waterbury, Conn.	War	Brass strip	129,509
Ex-Cell-O Corp., Detroit, Mich.	Navy	Pumps	170,673
Carlton Machine Tool Co., Cincinnati, Ohio.	Navy	Drills	111,378
Axelson Mfg. Co., Los Angeles, Calif.	Navy	Lathes	279,907
Cleveland Tractor Co., Cleveland, Ohio	War	Tractors	185,747
International Harvester Co., Chicago, Ill.	War	Cranes	374,593
International Harvester Co., Chicago, Ill.	War	Tractors	631,171
Harbor Boat Bldg. Co., Terminal Is., Calif.	Navy	Boats	1,027,500
Curtiss-Wright Corp., St. Louis Airplane Div., Robertson, Mo.	War	Airplanes	62,278,067
Leece-Neville Co., Cleveland, Ohio	War	Generator assem.	934,389
Bendix Aviation Corp., Eclipse Aviation Div., Bendix, N. J.	War	Generator assem.	859,293

E. E. MOORE

J. H. MACK

DONALD A. ROBISON

NAMES in the NEWS

Dr. W. D. Coolidge and Stuart M. Crocker have been appointed new General Electric vice presidents. Dr. Coolidge was director of the General Electric Research Laboratory in Schenectady, and Mr. Crocker served as manager of the company's air conditioning and commercial refrigeration department at Bloomfield, N. J.

Bernard M. Bickford has been appointed manager of the Evansville branch plant of Plymouth Division of Chrysler Corp.

Paul L. Gillan has recently joined the automotive and industrial engineering consultation staff of Aluminum Industries, Inc., Cincinnati.

Paul Keller has been appointed Cleveland district sales manager for Copperweld Steel Co., Warren, Ohio.

Arthur G. Kimball, president of Landers, Frary & Clark, New Britain, Conn., has been elected a governor of National Electrical Manufacturers' Association.

J. H. Mack, formerly vice president of Chrysler Corp.'s Fargo Division, has been appointed general service manager of the Corporation's Central Service Division, replacing H. J. Nestle who has resigned.

E. E. Moore has been elected vice president, industrial relations, Carnegie-Illinois Steel Corp. He succeeds D. A. Barrett who retired Dec. 1 upon completion of 44 years of service with the organization. Mr. Moore was appointed general superintendent of South Works, Chicago, in 1935 when Illinois Steel Co. became a part of Carnegie-Illinois Steel Corp.

Stewart W. Munroe has been appointed general sales manager of the Chrysler Corp. Mr. Munroe joined forces with Walter P. Chrysler in 1921 when Mr. Chrysler had just been appointed chairman of the board at Maxwell.

Donald A. Robison, formerly general sales manager, has been named vice president of the Caterpillar Tractor Co. with administrative direction of all selling and advertising activities. Gail E. Spain succeeds Mr. Robison as general sales manager.

Irvin A. Ruder has been appointed manager of the Merchant Iron & Steel Div., Iron & Steel Products, Inc., Chicago.

Robert W. Russell has been named special assistant to the general manager of the Hamilton Propeller Div., Bridgeport, Conn. Mr. Russell has been with the company since 1933. Harlan M. Ellis has been appointed sales manager of the organization.

Gaylord G. Thompson, formerly supervisor of the application and control of carbide tools at the Gisholt Machine Co., Madison, Wis., has just been appointed tool engineer for the McKenna Metals Co., Latrobe, Pa.

R. A. Travisano succeeds the late H. T. Smith as traffic manager of the Worthington Pump & Machinery Corp. Mr. Travisano has been connected with the Worthington Co. since 1912.

Claude K. Swafford, works manager of the Gisholt Machine Co., Madison, Wis., has been elected to the board of directors. H. B. Morey, treasurer, has been named vice president of the company and H. J. Homewood, assistant secretary, succeeds Mr. Morey as treasurer.

L. E. Waldron and M. S. Raudebaugh have been appointed to the staff of the Rawlplug Co., Inc., New York. Mr. Waldron's headquarters will be at Charlotte, N. C., while Mr. Raudebaugh will maintain his office at Toledo.

J. A. Williams, formerly assistant to the vice president and general manager of the Curtiss Airplane Div., Curtiss-Wright Corp., Buffalo, has been appointed manager of the organization's new aircraft factory now being built at Columbus, Ohio. Mr. Williams joined the Curtiss organization in 1921.

Joseph W. Yowell, formerly with Pan-American Airways, has joined Manning, Maxwell & Moore, Inc., Bridgeport, Conn., in charge of aircraft instrument sales.

Raymond W. Young, formerly assistant chief engineer of Wright Aeronautical Corp., Paterson, N. J., has been appointed chief engineer; Arthur H. Leak succeeds Mr. Young as assistant chief engineer.

W. C. Williams, Jr., Frederick C. Kroeger and Edward F. Fisher have been elected vice presidents of General Motors Corp. Mr. Williams was also elected a member of the administration committee of the organization.

PLANT EXPANSION

The Doehler Die Casting Co., Batavia, N. Y., will replace part of its magnesium and aluminum castings plant with two new buildings to cost approximately $200,000.

American-Marietta Co., Chicago, has started construction at its Kan-

New Vice Presidents at General Motors Corp.

W. C. WILLIAMS, JR.

EDWARD F. FISHER

F. C. KROEGER

kakee, Ill., plant of two new buildings to handle the increasing demand for the company's products. The buildings are part of a $200,000 modernization and expansion program at Kankakee that was begun about a year ago.

Bendix Aviation Corp., South Bend, Ind., has awarded contracts for the design and construction of a $500,000 addition to its plant to be completed by Jan. 1. The expansion will have a total area of 154,000 sq.ft. and will be devoted entirely to the manufacture of carburetors.

The Houde Engineering Corp., Buffalo, has awarded a contract for construction of a $125,000 addition to its Buffalo plant. The organization is also planning construction of a $500,000 plant to produce munitions.

Sheffield Gage Corp., Dayton, Ohio, is erecting a new air conditioned gage manufacturing plant. The new unit will provide 32,000 sq.ft. of additional floor space, is scheduled to be in operation in approximately six months, will cost approximately $1,000,000.

Timken Roller Bearing Co., Canton, Ohio, will build a $40,000 addition to its plant at Columbus, Ohio. The expansion will increase the original plant by 15,000 sq.ft.

BUSINESS ITEMS

Anker-Holth Mfg. Co., Inc., Port Huron, Mich., has acquired the physical assets of the Airgrip Chuck Co., Detroit. Operations will be transferred to Port Huron at once and will be continued under the direction of Leo T. Neidow who started the air chuck business in 1917. The new division includes a complete line of air chucks, cylinders and valves.

American Car & Foundry Co. has netted a profit of $823,654 as a result of its operations in the past six months. This contrasts with a loss of $1,746,678 for the corresponding period in 1939.

Bendix Aviation Corp., a General Motors Corp. affiliate, has arranged the purchase of a large section of the former Atwater Kent property in Philadelphia. The unit, known as Plant No. 6, was purchased for an all-cash consideration of $1,000,000.

Eutectic Welding Alloys, Inc., New York, N. Y., was recently founded to manufacture and distribute the Castolin welding alloys.

A. C. Harvey Co., Allston, Mass., have been appointed jobbers of the line of Hobart "Multi-Range" arc welders, Troy, Ohio.

Snyder Tool & Engineering Co., Detroit, has broken ground for a 90x138 ft. addition to its present plant. The new structure will house two 15-ton cranes and will afford room for additional engineering facilities.

The Otis-Fenson Elevator Co., Ltd., Hamilton, Canada, has placed machinery requirements for a $9,000,000 plant to make complete Bofors antiaircraft guns for England. The main structure will measure 300x1000 ft. A smaller one will be used for assembly and inspection. Over $7,000,000 will be spent on machine tools and fixtures. Between 8,000 and 10,000 jigs and fixtures will be required, many of which will be built in the U. S.

Sprage & Henwood, Inc., Scranton, Pa., and E. J. Longyear Co., Minneapolis, have been appointed sales agents for the newly introduced "Sinta-Set" diamond impregnated core-bits, produced by Carboloy Co., Inc., Detroit.

OBITUARIES

F. E. Bogardus, 54, ballistic engineer for the Remington Arms Co., Bridgeport, Conn., died recently at Bridgeport Hospital.

Arthur Brown, 61, superintendent of the Elmira Heights, N. Y., plant of the American Bridge Co., since March 1923, died recently following a two weeks illness. Mr. Brown was associated with the firm for 44 years.

Frank B. Hamerly, vice president of the Independent Pneumatic Tool Co., Chicago, died recently of a heart attack while inspecting the company's plant at Los Angeles.

Charles A. McCune, 61, research engineer and secretary of the Magnaflux Corp., New York, died recently in Atlantic City. Mr. McCune was a past president of the American Welding Society and of the International Acetylene Association, and a long-time coordinator of the activities of those societies with the activities of the A.S.M.

W. J. Austin, president of the Austin Co., Cleveland, Ohio, was killed at Chicago a week ago. He was a passenger on the airliner which crashed outside the landing field.

F. E. Saecker, 86, president of the Appleton Machine Co., Appleton, Wis., died recently at his home. Mr. Saecker had been president of the organization since it was founded in 1882. He was also an organizer of the Scolding Locks Corp., Appleton.

Frank Icke, 59, retired vice president and secretary of Fritzke & Icke, Inc., Milwaukee, makers of special machinery, died recently after a short illness. Last February Mr. Icke retired from the machinery firm.

MEETINGS

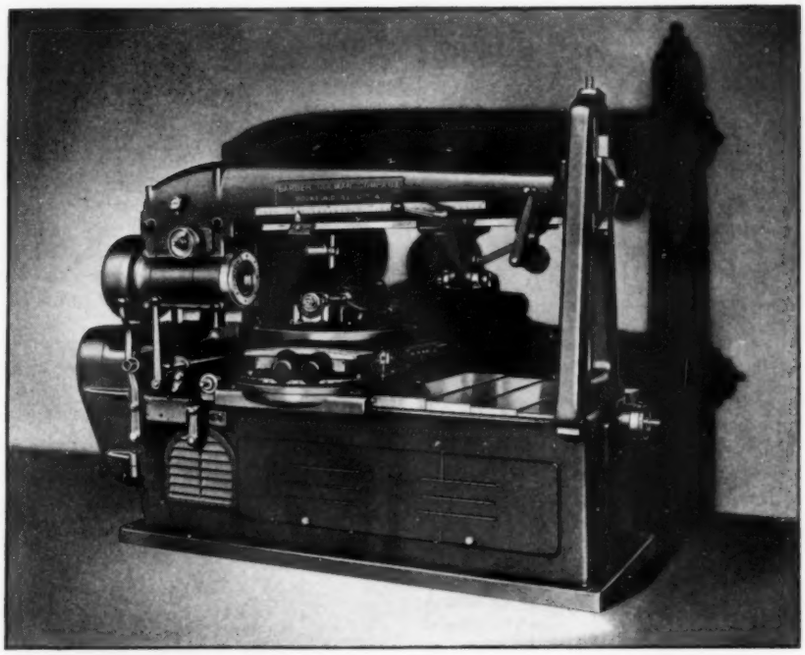
American Society of Mechanical Engineers. Semi-annual meeting. Kansas City, Mo., June 16–20, 1941.

Automotive Tool and Die Manufacturers Association. Annual meeting. Hotel Statler, Detroit, Mich., Jan. 21, 1941.

National Metal Trades Association. Annual meeting. Palmer House, Chicago, May 8-9, 1941.

Society of Automotive Engineers. Annual meeting, and engineering display. Book-Cadillac Hotel, Detroit, Mich., Jan. 6–10, 1941.

SHOP EQUIPMENT NEWS



Improved Barber-Colman Hobbing Machine Performs Wider Range of Operations

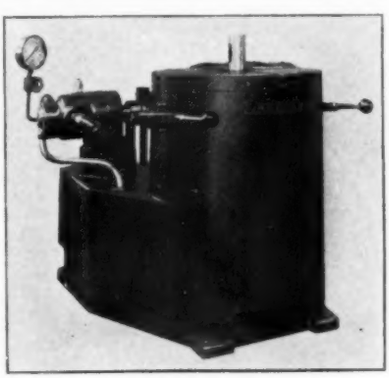
In many respects similar to the Type A hobbing machine, which was originally designed primarily for hobbing taper splines on shafts,, the Type T hobbing machine developed by Barber-Colman Co., Rockford, Ill., may also be used for standard hobbing of miscellaneous parts such as spur gears, spiral gears, straight splines, worms, worm wheels, and similar items.

The main point of difference from the previous machine is in the hob swivel construction, which provides a means to traverse the hob not only longitudinally, but also laterally. Changes also include the moving back of the hob spindle shoulder to accommodate standard hobs up to 4 in. in diameter and 4 in. long, and to permit a greater number of hob settings to be made.

Operating and control mechanisms are somewhat different from those of the Type A machine. There is an additional feed screw in the lower hob swivel slide to give the hob its longitudinal traverse. A special micrometer dial on the work slide permits the operator to read the work spindle height above the hob spindle. A similar dial on the main feed screw shows the distance between the spindle nose and the hob carriage unit. A scale mounted on the overarm helps position a fixed stop for properly loading work. A single large gear box contains all change gear trains. This permits a complete change gear set-up to be completed in one position. All controls are mounted on the left hand front of the machine, convenient to the operator.

30 Ton Pull Press Developed by Greenerd

Greenerd Arbor Press Co., P. O. Box No. 415, Nashua, N. H., has developed the No. H 70 P 30-ton pull type press especially for those assembly jobs which require a pull rather than a push.



Completely self-contained, this machine has a 24-in. diameter working table located 34 in. above the floor. The $2\frac{7}{16}$-in. alloy steel hardened and ground ram is slotted to receive a drift pin. Ram travel is 17 in. Rapid traverse speed is 138 in. per min.; working speed at 15 to 30 tons pressure is 38 in. per min. Press is operated by a 10 hp. 1200 r.p.m. motor and starter for 220/440/550 volt, 2 or 3 phase, 50 or 60 cycle current.

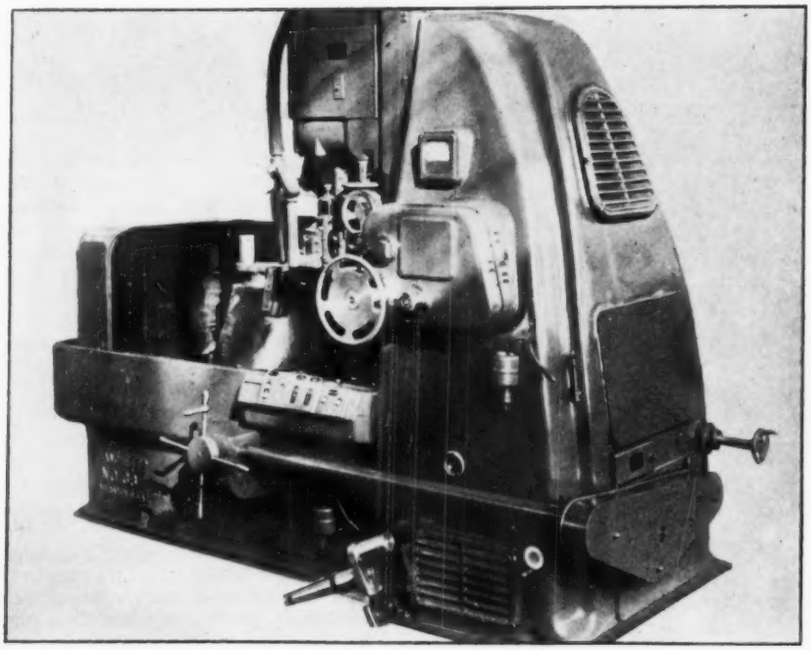
Allis-Chalmers Introduces "Weld-O-Tron Junior"

Allis-Chalmers Mfg. Co., Milwaukee, Wis., has added a "Junior" size to its line of "Weld-O-Tron" low-current electronic arc welders for light gage metals. Having a capacity of 5 to 40 amp., it is especially designed for those plants already equipped with motor generator welders to handle currents as low as 35 to 40 amp.

Like the larger units, this smaller size supplies currents as low as 5 amp. and uses electrodes as small as $\frac{1}{32}$ and $\frac{1}{16}$ in. in diameter. It is especially suited to welding gages from 32 to 18, and is capable of handling material as thick as 14 gage.

Welder consists essentially of a three-tube polyphase mercury vapor rectifier circuit, eliminating all rotating parts. Readily accessible controls and terminals are located on the front panel. They are of the dead front type and consist of a simple two-way switch for changing polarity. A handwheel with easily read dial provides fine adjustment of the welding current.

Special Hanchett Rotary Surface Grinder Built to Finish Aircraft Engine Crankshafts



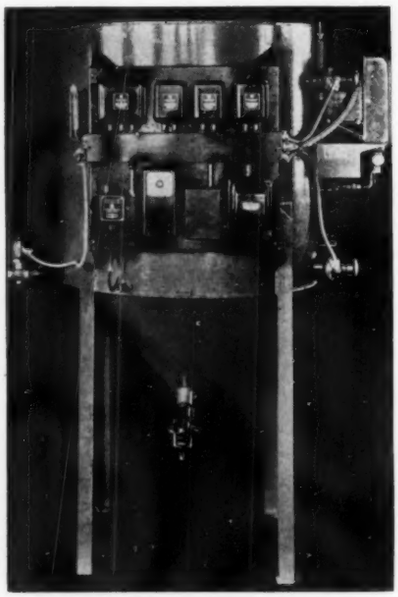
Hanchett Mfg. Co., Big Rapids, Mich., has developed a special adaptation of its No. 36 rotary surface grinder to grind aircraft engine crankshafts. The machine is fitted with a Hanchett-designed fixture to hold the crankshaft solidly so that the face where the counterweights are later attached can be ground square with the axis of the shaft to within 0.0004 in.

The grinder is equipped with an 18-in. cylinder wheel, which has a special diamond dresser to give the required radius to one corner. The wheel is driven by a 30-hp. 900-r.p.m. built-in motor. The rotary fixture table is mounted on the conventional carriage, its position under the grinding wheel controlled by a large handwheel at the front of the machine. This control permits accurate positioning of the crankshaft. Operated by a handwheel at the back of the machine is a micrometer screw stop which determines the correct grinding position for each succeeding crankshaft. There is a 175-gal. coolant tank in the bed of the machine, with a motor-driven pump. Entire grinder weighs approximately 19,000 lb., ready to operate.

Barrett Sterilizing Unit Cleans and Purifies Coolant

The combination sterilizer and sedimentator developed by Leon J. Barrett Co., Worcester, Mass., sterilizes and removes sediment from coolant in the same operation. The sterilizer is placed in the oil line between the extractor and the supply tank. Thus, located, it eliminates recently liberated germs that otherwise may immediately follow through the supply to a scratch on a man's hand or arm. The potency of infection is thus intercepted, forestalling expert medical treatment.

The complete unit is a round tank with conical bottom. Heating under thermostatic control is by steam, electricity or gas. Coolant enters low and is distributed through the heated area, rising slowly during a 20-min. interval to an outlet near the top; it then drains by gravity to the supply tank. During the process the sediment settles out, accumulating in the funnel-like base.

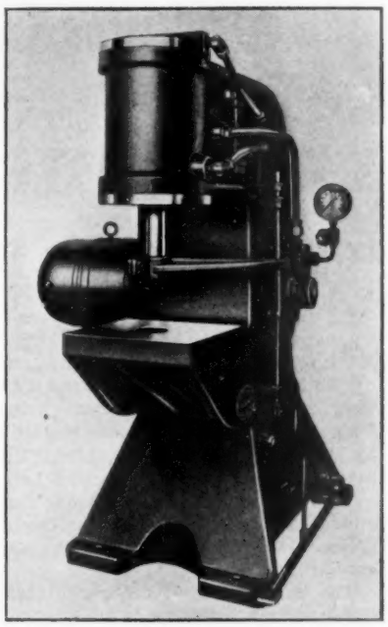


A special built-in wing scraper for unseating precipitated solids is actuated by a handwheel at the bottom. Clean-out is a simple matter of opening an outlet valve in the side near the bottom in the area swept by the scraper.

Greenerd Hydraulic Press Has 30-Ton Capacity

The No. H-70 hydraulic press offered by Greenerd Arbor Press Co., P. O. Box No. 415, Nashua, N. H., is self-contained, with pressure variable from 6 to 30 tons on the down stroke. Frame and cylinder are cast of semi-steel and the cylinder is honed to size.

Motor and pump are mounted on opposite sides of the main housing, being directly coupled. Oil sump is in the base. The 9-in. piston is



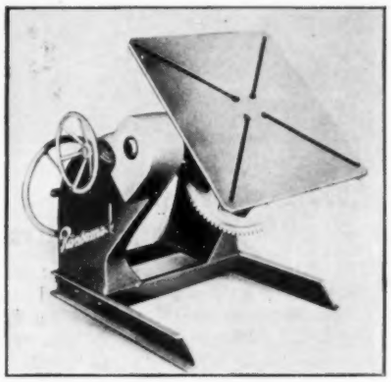
equipped with six cast iron rings. Ram is made of heat-treated alloy steel, hardened and ground, $2\frac{7}{16}$ in. in diameter. Working table is 18 in. wide, 15 in. deep, with a $3\frac{1}{2}$ in. hole central with the ram.

Rapid traverse speed of ram up to 15 tons pressure is at the rate of 138 in. per min., with instantaneous change-over to a working speed of 38 in. per min. within the range of 15 to 30 tons pressure.

The machine is designed to receive work up to 22 in. diameters; height over work table is 14 in. Stroke of ram is adjustable from 1 to 10 in. Press is equipped with a 10 hp., 1200 r.p.m. motor and starter for 220/440/550 volt, 2 or 3 phase, 50 or 60 cycle current.

Ransome Welding Positioner Handles 2500-Lb. Parts

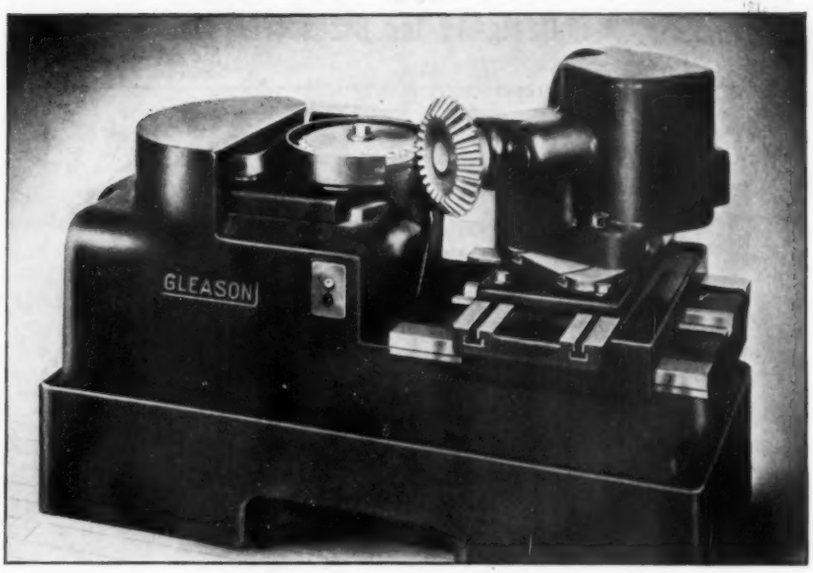
A positioner for pieces weighing up to 2500 lb. has been designed by Ransome Concrete Machinery Co., Dunellen, N. J., to facilitate handling of material in welding shops. The all-welded table top, with T-slots for easy clamping, revolves a full 360 deg. and tilts 135 deg. beyond horizontal. A worm and worm wheel arrangement makes the table self-locking when handling unbalanced loads. The machine is available with handwheels for manual operation or with tilting and revolving motors with remote control pushbuttons.



Crane Limit Stop Prevents Overtravel

Cutler-Hammer, Inc., 205 N. Twelfth St., Milwaukee, Wis., has developed a new type of main circuit crane safety limit stop to prevent overtravel of the crane hook when hoisting. This device operates by means of a counter-weighted lever and a suspended reset weight.

As the hook approaches its limit of travel the reset weight is raised, thus allowing the counter-weight to trip the switch. A quick make and break mechanism opens the normally closed power contacts to disconnect the motor from the line and closes another set of contacts to connect a resistor across the motor circuit and establish smooth dynamic braking. Taps are provided to adjust braking in accordance with service conditions. When the limit stop is in the tripped position, a by-pass circuit is established which permits backing out.



Gleason Straight Bevel Gear Rougher Rapidly Produces Correctly Tapered Tooth

A new method of rough-cutting straight bevel gears to produce rapidly a correctly tapered tooth slot is employed in the No. 7 straight bevel gear rougher developed by the Gleason Works, Rochester, N. Y. This machine is suitable for the roughing of straight bevel gears up to 14 in. pitch diameter and 6:1 ratio in large or medium quantities.

The outstanding advantage of this new type of machine is said to be close roughing both as to taper and tooth profile. Other important advantages are high rate of production and ease of set-up and operation. Fast cutting is possible because of rigid construction and the small number of moving parts. Use of a hydraulic chuck and hydraulic movement of the workhead also adds to speed and convenience of operation. A minimum of attention is required, as only the changing of the work and the pushing of the starting button are needed to operate the machine.

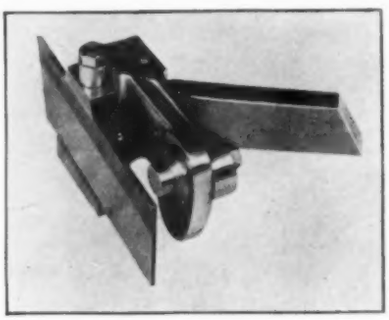
Proper taper and profile shape of the tooth slot are obtained by the combined effect of the cutter blade shape and a horizontal motion of the cutter spindle. A disk cutter which has blades extending radially from the cutter body is mounted to rotate in a horizontal plane. One cutter covers a limited range of gears and pinions.

A single hydraulic control lever operates the workhead for changing blanks, including chucking, movement of the head, and clamping of the head. Indexing of the work spindle is controlled by change gears. Lubrication of the machine, except for the motors, is entirely automatic.

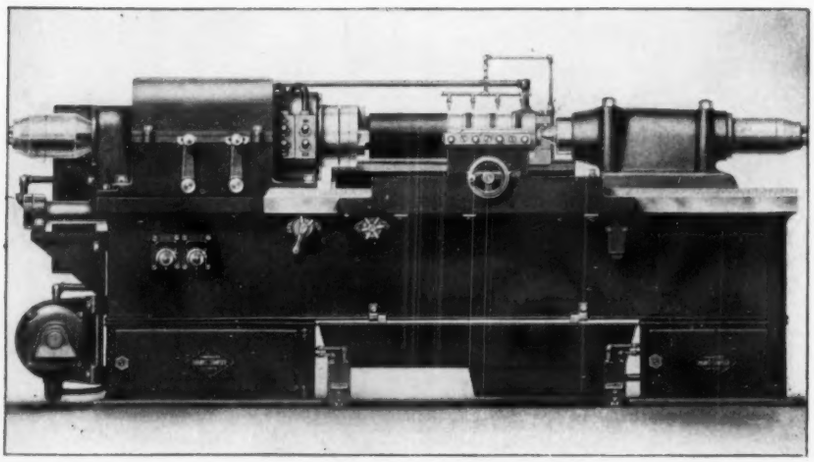
Specifications: Maximum pitch diameter (6:1 ratio), 14 in.; coarsest pitch, 3 d.p.; greatest face length, 2 in.; extreme ratio (shafts at 90 deg.), 6:1; cutter diameter, 15 in.; net weight (approximate), 9,000 lb.

Anthony Cutting Off Tool Said to Eliminate Chatter

Chattering is claimed to be eliminated in the line of cutting off tools introduced by Anthony Cutting Off Tools, P. O. Box 1684, San Antonio, Texas. With these tools stock up to 10 in. in diameter can be easily and safely cut off, an operation made possible by the supported blade which gives strength and the safety slip which eliminates breakage. The diameter that can be cut is claimed to be limited only by the swing of the lathe. Four sizes are stocked, for diameters of 4, 6, 8 and 10 in. Still larger sizes are available on special order. It is claimed they will cut successfully diameters up to 16 in.



Sparks-Simplex "Hydro-Matic" Shell Lathe Designed for Sizes from 75 to 155 Mm.



Sparks-Simplex Machinery Corp., 49 Wall St., Norwalk, Conn., has developed the No. 101-A "Hydro-Matic" lathe especially for the manufacture of shell and small guns. This lathe is said to be capable of all machining operations of all sizes if shell from 75 to 155 mm., with construction rigid and rugged enough to accommodate multiple tooling with the maximum cutting speeds permitted by carbide tools.

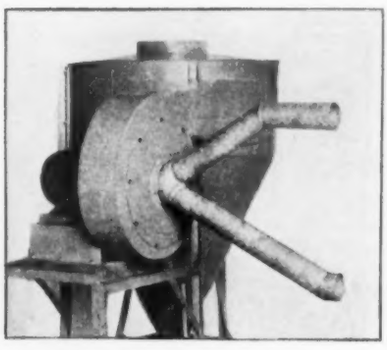
Principal features of the lathe include Timken bearings throughout, chain drive with arrangements for mounting motors of 10 to 50 hp., three-speed headstock, and hydraulic longitudinal feeds with automatic stop and rapid traverse. Feeds from 0.008 to 0.040 in. are obtained by adjustment of a dial on the front of the machine. Power hydraulic cross feeds are supplied independently of the longitudinal feeds, eliminating necessity for any controlling cam feeds and simplifying manufacture and operation. Heavy-duty motor drive coolant pumps are supplied. Large capacity chip pan can be easily cleaned from the back.

In cooperation with Cushman Chuck Co., a complete set of chucks for all shell sizes has been developed. Quick chucking on inside chucking operations is accomplished by hydraulic cylinders connected through the spindle and operated through the main hydraulic supply line. This is claimed to give sufficient inside pressures on the chuck jaws to hold all sizes, regardless of the cutter depth or number of tools operated.

This lathe, with the same type of hydraulic feed, can be used for turning smaller anti-aircraft and tank guns by the use of extra long boring attachments and longer beds. Standard lathe weighs about 7500 lb.

Leiman Dust Collector Employs Double Suction

Double suction is a feature of the self-contained dust collector built by Leiman Bros., Inc., 101-EE-2 Christie St., Newark, N. J. This unit has been specially designed for drawing dust away from the top as well as the bottom of a buffing or grinding wheel. The branched piping may also be adjusted so that the unit collects dust from two wheels at the same time. Collector is a complete unit, readily portable. It is available for one or two wheels up to 24 in. in diameter.

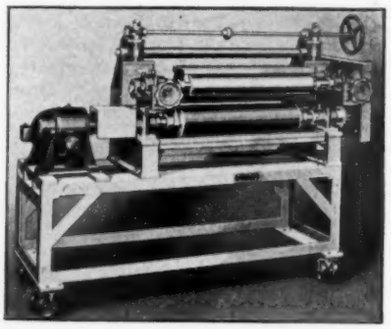


Francis Coating Machine Applies Draw Lubricant

Chas. E. Francis Co., Rushville, Ind., has developed a coating machine for applying draw compound to steel sheets preparatory to shaping or forming.

Machine includes two corrugated rubber rolls for coating sheets on both sides. A doctor or scraper roll is used in conjunction with each coating roll, not only to govern the thickness of spread but also to form a roll crotch to hold the compound. If so desired, the lower roll can be adapted to pick up its supply of mixture from a stationary or adjustable pan. Calibrated adjustments govern the spread and adjust opening between the rolls for thickness of metal.

Drive is by a direct-connected geared-head motor. Machine is furnished on a welded steel stand mounted on casters, to permit moving to different positions. It can be had in any width, in regular or extra heavy construction, in bench or floor model, for single or double coating.



7,000-Lb. Load Handled By Clark "Utilitruc"

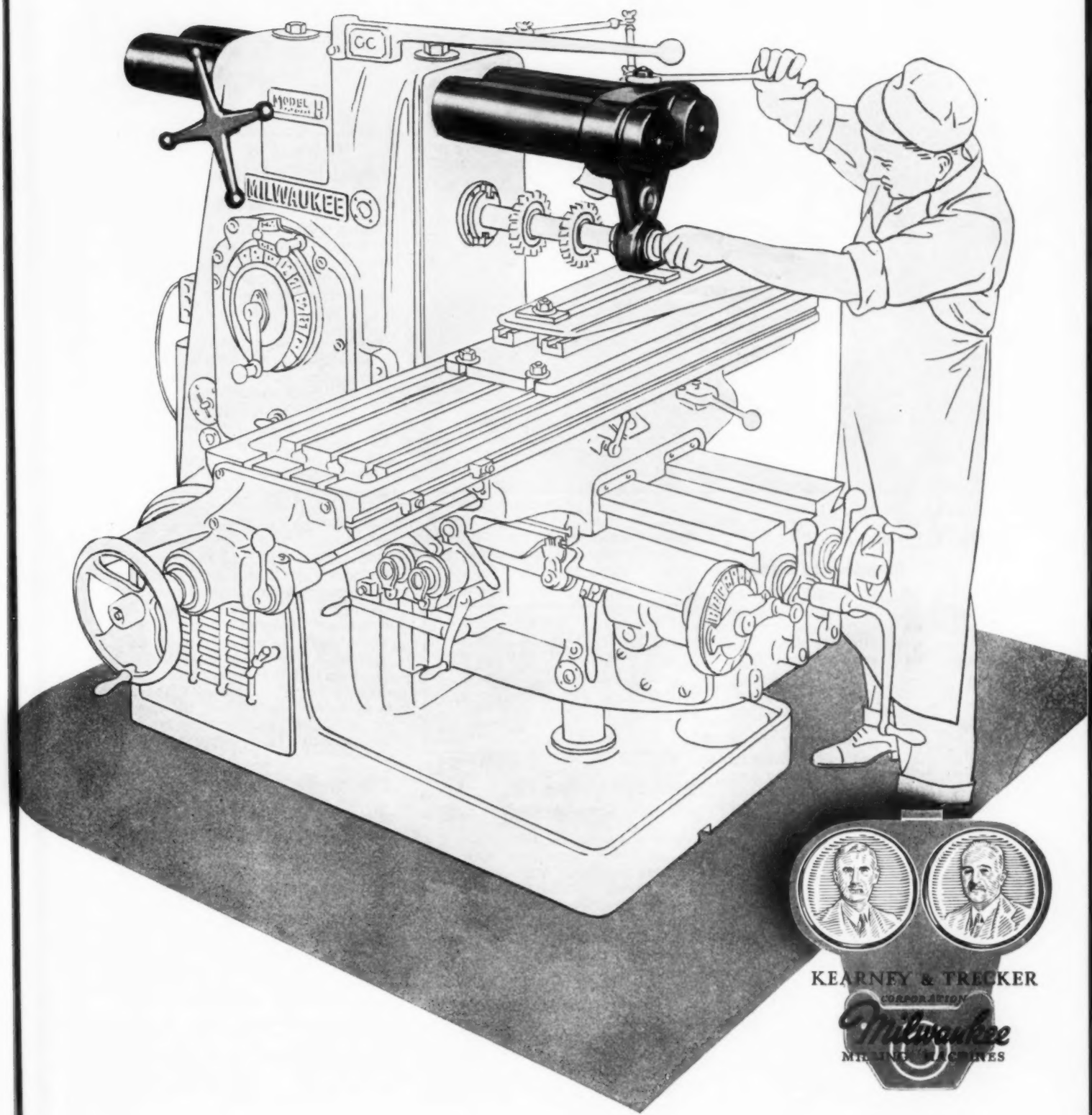
The "Utilitruc" lifting, carrying and tiering fork truck introduced by Clark Tructractor Div., Clark Equipment Co., Battle Creek, Mich., will handle loads as heavy as 7,000 lb. and tier them in piles over 15 ft. high. This truck is said to be particularly efficient in car loading and unloading operations, in utilizing storage capacity to the full by high stacking and in serving production machines with materials and parts from storage. Gas-powered, it is capable of 24-hr. continuous operation.

The truck is made in several models, including straight lift, tilting and telescopic tiering. Minimum height is 61½ in., enabling the truck to negotiate low doorways. Minimum capacity is one ton. Heavy steel fingers, with chisel points, vary in length and are adjustable sidewise on the front plate. The operator inserts these fingers under any cleated or uncleated load, lifts the load clear of the floor, tilts it back 10 deg. in 1 sec. for safe riding, elevates it at the rate of 7 in. per sec., and tilts it forward 3 deg. in ½ sec. for easy tiering.

Machine is powered with a 6 cylinder heavy-duty tractor motor. It travels at speeds from 1 to 7 m.p.h.

In the advancement and development of milling machines, the overarm has played an important part. The construction of the Milwaukee double overarm increases rigidity and provides easy access to the arbor and cutters — a most important convenience to the operator.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis. U. S. A.

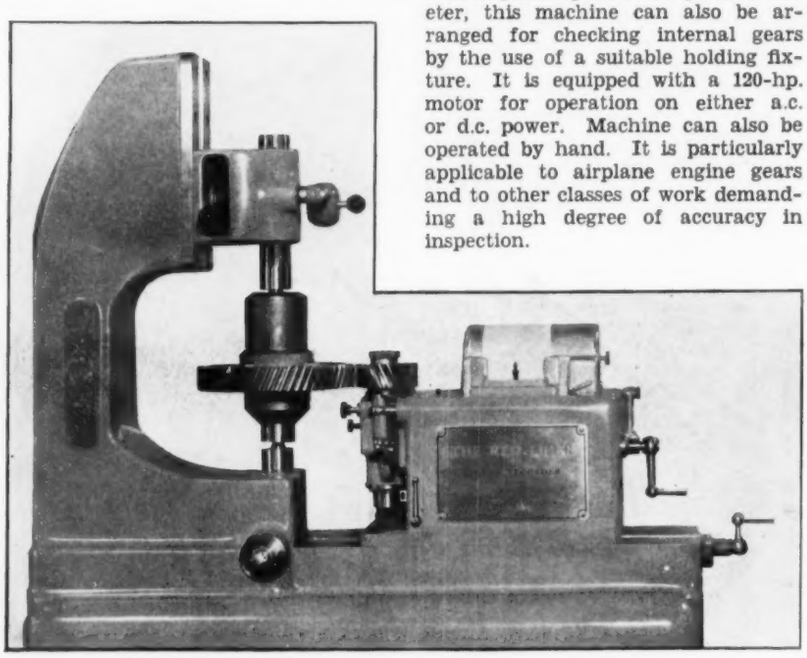


MILWAUKEE MILLING MACHINES

Fellows "Red Liner" Gear Checker Handles Gears on Adjustable Centers

The No. 20M "Red Liner" gear checking machine built by Fellows Gear Shaper Co., Springfield, Vt., operates on the same fundamental principle as the regular "Red Liner" machine, but is arranged to handle gears on centers which are adjustable. The lower center is adjustable to present the gear in the correct relationship to the master gear, while the upper center is adjustable for handling gears or arbors of different lengths.

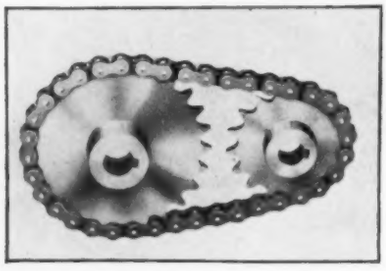
Capable of checking both spur and helical gears up to 18 in. pitch diameter, this machine can also be arranged for checking internal gears by the use of a suitable holding fixture. It is equipped with a 120-hp. motor for operation on either a.c. or d.c. power. Machine can also be operated by hand. It is particularly applicable to airplane engine gears and to other classes of work demanding a high degree of accuracy in inspection.

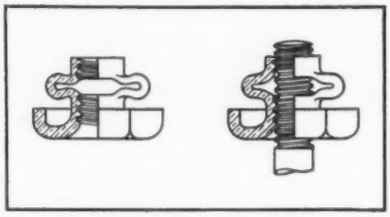


8-Mm. Roller Chain Developed by Diamond

Weighing almost exactly half as much (1¾ oz. per ft.) as the smallest power transmission chain previously produced in the United States, No. 88 roller chain announced by Diamond Chain & Mfg. Co., Indianapolis, Ind., has been developed for dependable performance in services for which other roller chains are too heavy or bulky.

In spite of its minute dimensions, with rollers 0.197 in. in diameter and 0.125 in. in width, this chain averages 1100 lb. ultimate strength. It is practical for power transmission at extremely high speeds and for applications for which maximum compactness without sacrifice of enduring accuracy is essential—for positive driving of light-weight machinery, for timing mechanisms, for precision instruments and equipment, for facsimile models, etc.

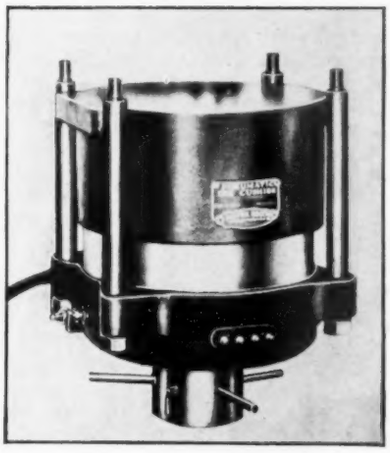




Boots Self-Locking Nut Manufactured by Scovill

A vibration-resisting, self-locking nut of the wing style has been announced by Scovill Mfg. Co., Waterbury, Conn., manufacturer and distributor for Boots Aircraft Nut Corp. When applied, the spring member of the nut expands to locking position, providing a constant tension.

In addition to the vibration-resisting feature, this nut presents all the advantages of the solid type, but is 10 to 50 per cent lighter and generally, size for size, cheaper. It is of all-metal, one-piece construction, and reduces labor and material costs of assembly. It is fabricated from steel and cadmium plated. Present sizes run from No. 6 through ¼ in.



Pneumatic Die Cushion Available in Seven Sizes

Dayton Rogers Mfg. Co., 2830 S. Thirteenth Ave., Minneapolis, Minn., has made available the Model D improved universal pneumatic die cushion, in seven sizes from 6 to 14 in., having capacities for deep drawing work from 2 to 6 in. for use with or without tank reservoirs.

Each cushion is supplied with a combination reducing regulating control valve and pressure gage. The die cushion may be mounted directly to the bottom side of the bolster plate, for all draw ring and pressure pad control operations, or spaced away from the bolster plate to any desired distance to allow blanks or slugs to pass through.

Correct height of the pin pressure pad is predetermined and maintained by the handwheel, thus compensating for bolster plate thickness variation, sharpening and grinding of dies, and changes in die design. Cylinder and piston are inverted on the section which serves as a pin pressure pad, making it possible to drop the pin pressure area to the maximum of the drawing stroke by releasing the air pressure and shutting off the supply so the pinplate stands out of the way for blanking and piercing operations.

Clemson Hacksaw Blade Claimed to Be Unbreakable

A tungsten-alloy hacksaw blade with the cutting qualities of all-hard tungsten blades, yet claimed to be so flexible that it cannot be broken in a frame, has been announced by Clemson Bros., Inc., Middletown, N. Y. This blade, known as the "Star" Unbreakable Special Flexible, is said to obtain its combination of opposing qualities through the use of a new tungsten alloy, heat-treated by a recently developed process.

The blade bears an all-over patented green metallic coating for protection, lubrication and identification, marking the first time a tungsten blade has been offered with an all-over finish in color.

Announced Sept. 3rd—Thousands already in Use!

Industry rapidly adopts—

NEW...CARBOLOY STANDARD TOOLS FOR "UNIVERSAL" SHOP USE ON 80% OF ALL TURNING, BORING, FACING JOBS!

Detroit, Sept. 3.—Mass production on a standardized line of Carboloy tools, designed to cover 80 per cent of all applications for cemented carbide tools, was announced by Carboloy Company, Inc., today.

The introduction of this simplified line of tools—comprising but five styles in three different grades—together with the economies resulting from mass production, has made it possible to price these complete tools well below comparable tools in the past, a typical new 'standard' tool, Style 4, now priced at only $1.85, comparing with tools previously costing $5.84 in lots of one. In quantities of 50 or more this typical tool now costs only $.90.

The program that has made this unprecedented step possible has been under development for the past three years. In the period from 1929 to 1937 prices of Carboloy cemented carbide

Style No. 1—Standard Tool
Available in 9 sizes

were progressively reduced four times as the result of economies resulting from increased consumption. About that time it became apparent that to widen the scope of useability of Carboloy tools required a complete revision of the principles under which such tools had been produced and sold up to then. What was needed was mass production of complete carbide tools on a scale never before attempted in this country.

Since 1937 extensive research work in the laboratory and in the field has been devoted to determining the fewest number of 'grades' of Carboloy and the simplest line of tools that would meet the vast majority of all carbide tool applications.

New $1,000,000 Plant Part of Program

Early in 1938 this development work had progressed to a point where Carboloy Company could proceed

Style No. 4—Standard Tool
Available in 9 sizes, left and right hand

with its next step—the expenditure of a million dollars on a new plant and equipment to expand and concentrate manufacturing activities. This plant, completed in the spring of 1939, was designed with a production capacity of ten times the amount of cemented carbide then consumed by industry, with provisions for expanding metal production to many times that amount.

Since that time, research and field experimental work has resulted in reducing the number of grades of Carboloy required for the vast majority of applications to only three —one new grade for steel cutting, and two for cast iron. Further, it was found that five styles of tools in each of these grades would cover 80 to 90 per cent of all turning, boring and facing applications.

The basic design of these tools is

Style No. 13—Standard Tool
Available in 5 sizes, left and right hand

such that several hundred variations can be rapidly ground in the tools by the user to meet special requirements. With the fast, simple grinding procedure developed during the past five years and now widely used by industry, such tool changes can be rapidly and economically accomplished. This rapid grinding procedure, plus the fact that the price of these new standard tools is comparable to that of many ordinary tools, brings to the field of Carboloy tool use a flexibility that permits broad 'universal' use of these tools within the average shop on short job-lot work as well as production runs.

The new standardized tools are carried in stock, ready for shipment, completely ground and ready for use. An extremely valuable feature is the incorporation of a ground-in chip breaker on all standard tools designed for the machining of steel, at no additional charge.

The new program, according to the announcement, is anticipated to produce a wider scale use of carbide tools, thereby reducing the cost of production of basic cemented carbides to [illegible] that in spite of higher [illegible] cost.

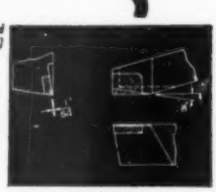
Carboloy Announces 6th Price R[illegible]

Since the year when Carboloy tools were first introduced it has been [illegible] Carboloy Co[illegible]

For a number [illegible] have realized tha[illegible] reducing the P[illegible] lev[illegible]

- ✓ LOW PRICED! *(Check against any other cutting tools)*
- ✓ SIMPLIFIED ORDERING!
- ✓ SIMPLIFIED TOOL STOCKS!
- ✓ IMMEDIATE SHIPMENT!
- ✓ YOU GET THEM ALL GROUND READY FOR USE!

(Steel cutting tools furnished with ground-in chip breaker)



Example of chip breaker ground in steel cutting tools.

Have You the Facts?

WRITE FOR CATALOG GT-125

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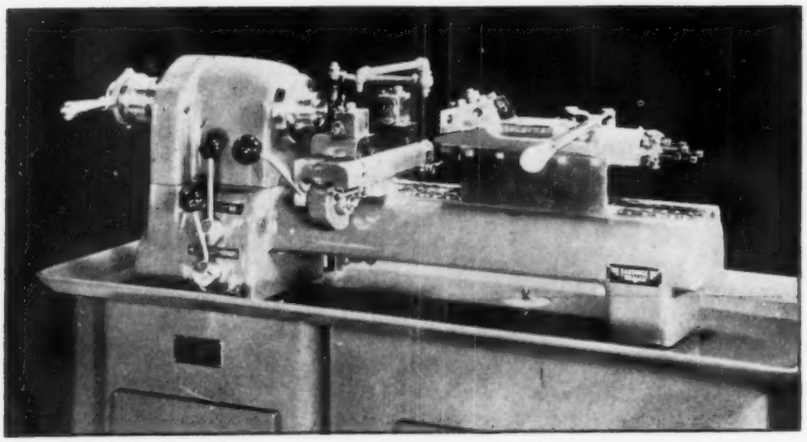


Hardinge Precision Second Operation Machine Developed to Handle Hand Screw Machine Work

Hardinge Bros., Inc., Elmira, N. Y., has developed its high speed precision second operation machine to perform the same operations as its previous hand screw machines. This machine, designed for fast production with high precision, features an inclosed head with preloaded ball bearing spindle construction, electrical driving unit with multi-speed motor, eliminating all gears, clutches and pulleys, convenient lever speed control at the headstock, and all steel welded pedestal.

Machine bed is amply proportioned and rests on three spheres for perfect three-point suspension. Headstock employs bearings fully inclosed in an inner chamber. Rear of the spindle carries a double pulley for two V-belts from the driving unit. These belts may be changed without removing the headstock spindle or bearings.

Automatic collet closer permits rapid opening and closing of the collets or step chucks while the spindle is at speed or stopped. Collets or chucks are easily opened by moving the conveniently located lever from left to right. Closer is adjustable so that any collet or step chuck tension may be applied on the part.

Rugged double tool cross slide has adjustable tool blocks and tool bit holders. Positive stops assure accurate cross slide forming. Standard circular form tool holders may be applied to the adjustable block in place of the tool blocks.

Tilted hexagon turret provides greater rigidity and tool clearance. Turret head is automatically indexed and locked into position by moving the operating lever to the extreme right. At the same time, the six independent turret stops are indexed, affording rapid and accurate turret operation.

Two levers at the headstock control spindle speed through electrical motor controls. There are eight forward and eight reverse speeds ranging from 230 to 3900 r.p.m. Pedestal has a built-in coolant system.

Welded steel pedestal completely incloses the motor and driving unit. Motor is completely insulated from the pedestal by rubber cushions. A brake rapidly stops spindle. Machine has a 1-in. collet capacity, 6-in. step chuck capacity and 9-in. swing.

Vibration Frequency Meter Has 500—20,000-Cycle Range

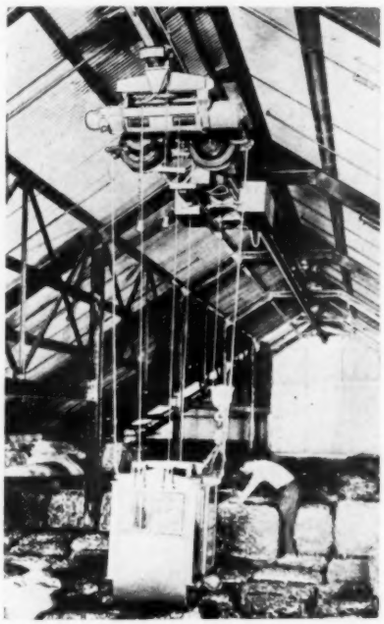
No larger than a slide rule, an 8-oz. vibration frequency meter developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., indicates frequencies from 500 to 20,000 cycles per minute. This compact device consists of a thin spring steel vibrator clamped at one end between a set of steel rollers. A knurled knob rotates the rollers, moving the reed in or out, changing its vibration frequency. A sliding pointer on the reed indicates the frequency.

To use the meter, its head is held against the vibrating body and the adjusting knob rotated until the vibrator reed moves to and fro at maximum amplitude. If more than one frequency exists, there will be a point of maximum amplitude for each.

Raise-Lower Tramrail Cab Made Available by Cleveland

Cleveland Tramrail Div., Cleveland Crane & Engineering Co., Wickliffe, Ohio, has developed a type of tramrail carrier with raise-lower cab. Available in two general forms, this equipment provides for the raising and lowering of cab and load together, or for the cab and load to be raised and lowered independently.

With a raise-lower cab unit one operator may take care of all operations involved in moving materials with an electric cab-controlled overhead tramrail system: attaching load to crane hook, detaching, and operating the tramrail unit. If the materials are of such nature that a lifting fork is needed, one operator can also handle the entire job just as with a crane hook. Unit shown has a vertical travel of 40 ft. for both cab and hook. Equipment can be furnished for operation from much greater heights if desirable. Load hoist, cab hoist and carrier are all motorized and controlled from the cab.



100-Watt Fluorescent Tube Offered by Westinghouse

A 100-watt Mazda fluorescent lamp has been announced by the Westinghouse Lamp Div., Bloomfield, N. J. Five feet long and 2½ in. in diameter, this tube will be available in the 3500 F. white color, which has proved most popular and adaptable to the greatest number of uses. The 100-watt lamp adds a seventh size to the line of fluorescent lamps now manufactured by Westinghouse. Allowing higher mounting heights, the lamp will reduce the size and number of fixtures necessary to supply a given amount of light. It has a rated initial output of 4,400 lumens and a rated life of 2,000 hours.

HOBBING GEARS TO MEET TOUGH SPECIFICATIONS . . .

HOBBING gears of extreme hardness (325—350 Brinell) as used in oil well pumping reducers—for particularly arduous duty—was the problem of a Chicago manufacturer. In cutting and maintaining this unusual hardness and maintaining high accuracy, Cities Service oils were used as the cutting lubricant.

No doubt you have one or two like problems in your shop. Why not find out what our lubrication engineers can do for you in your own shop with the right metal cutting lubricant? Just write us to have a lubrication engineer call.

Copies of our booklet on "Metal Cutting Lubrication" are available to users of metal cutting lubricants. Write for your copy today, before the supply is exhausted.

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CITIES SERVICE OIL COMPANY,
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Please send me information concerning your Lubrication Engineers' Service ☐

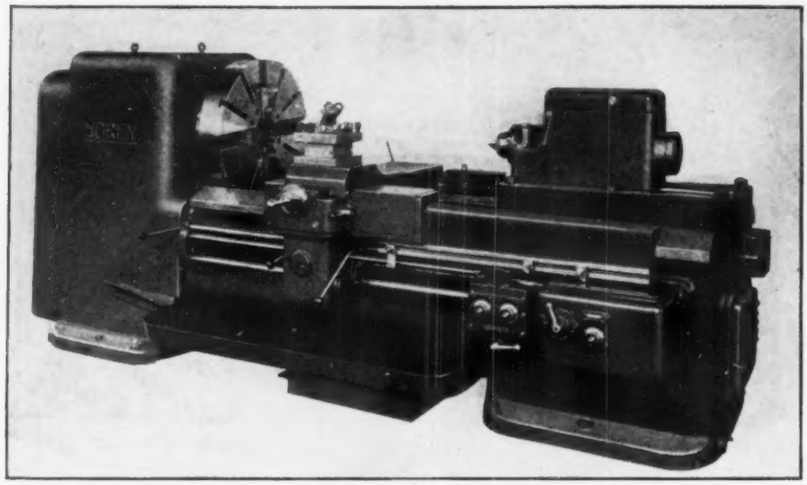
Please send me booklet on Metal Cutting Lubrication ☐

Name.....*Title*.....

Business Address.....

Firm Name.....

City.....*State*.....



Morey Heavy Duty Hydraulic Lathe Is Especially Adapted to Shell Machining

Featuring directional fingertip control, the 27-in. heavy duty hydraulic manufacturing lathe offered by Morey Machinery Co., 410 Broome St., New York, N. Y., is especially adapted to the machining of such munitions items as shell. Designed for single purpose operations, this lathe is built to utilize the maximum speeds and feeds which present day cutting materials permit.

Machine is assembled from a number of basic units so that a combination of them will produce a complete line of equipment for machining the shell from the rough forging, ready for thread milling. The lathe is also built with a hexagon turret with individual stops, mounted on a separate saddle.

Spindle is mounted on Timken bearings, front and rear. Diameter of spindle bore is 6 in. Main drive herringbone gear is 22 in. in diameter, driven through spiral pickoff gears, a twin disk clutch and multiple V-belt from the motor. All driving mechanism is inclosed in the headstock and is controlled at the carriage. Hydraulic feeds are controlled from the carriage apron, so that the operator's position remains with the cutting tools. Controls are interlocked so that when the clutch lever is thrown out to stop the spindle, the feeding mechanism stops automatically.

Carriage can be supplied in five combinations to cut a great variety of work. Tailstock requires no manual effort for operation, and is directionally controlled by a single lever, operating a complete hydraulic circuit.

"Protectoglo" Relay System Guards Against Flame Failure

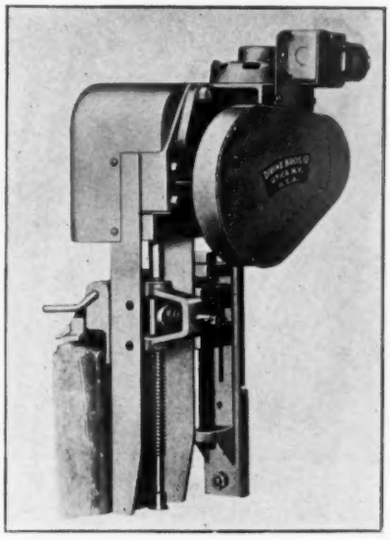
What is claimed to be a safe and reliable method of protection against failure of oil, powdered coal, and other luminous gas flames is announced by the Brown Instrument Co. Div., Minneapolis-Honeywell Regulator Co., Philadelphia, Pa. Known as the "Protectoglo Photo-Electrode" system, this method utilizes a photo-electric principle whereby the necessity of placing a metallic electrode in the high temperature is avoided, but which retains the quick response characteristic of thermionic systems.

Operation of the system is similar to the "Flame-Electrode" system. The principle difference lies in its method of flame detection. Instead of using a metallic electrode, it detects the presence of a flame by the light emitted when a burner is in normal operation. Light from the flame is directed upon a photo-cell. This results in a small flow of current through the cell which is amplified by a vacuum tube circuit until of sufficient magnitude to close a relay. Through the relay contacts, the main fuel valve is energized.

Divine Composition Applicator Saves Time and Compounds

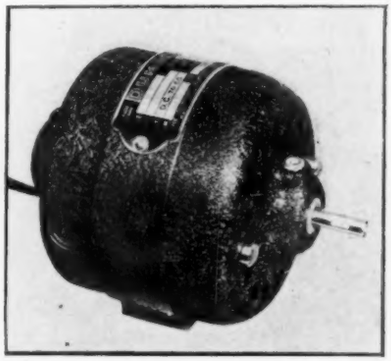
The Model AK-4 automatic composition applicator introduced by Divine Bros. Co., Utica, N. Y., is claimed to save time and conserve buffing compounds by automatically applying compounds to the face of buffing wheels, in an exact amount at the proper time. This applicator can be used in conjunction with lathes for hand buffing, and is especially suitable for all types of automatic and semi-automatic buffing machines.

The device is easily moved from one machine to another, the applicator being a self-contained unit. It can be mounted in any position, either horizontal or vertical.



Improved Dumore Motors Have Self-Aligning Bearings

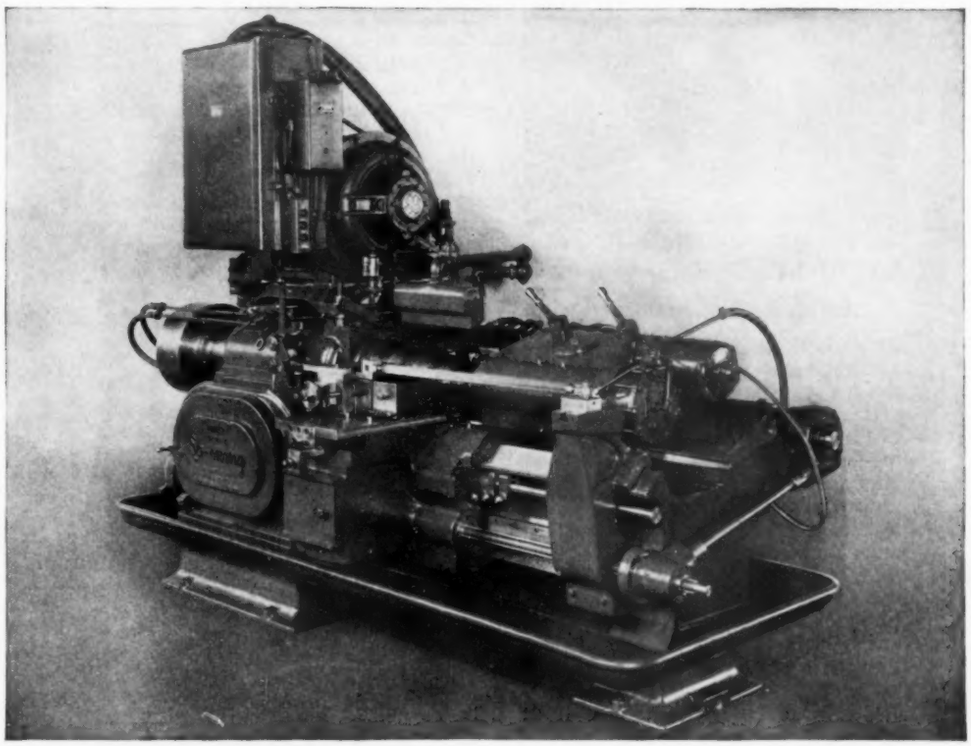
Dumore Co., Racine, Wis., has improved its types A and A3 fractional-horsepower motors by the addition of self-aligning bearings and incorporation of slight changes to improve appearance. The new motors, identified as types AA and A3A, are rugged, general-purpose power units suitable for either a.c. or d.c. operation. Power outputs of the two motors, respectively, are 1/30 and 1/15 hp. when operating on alternating current and 1/20 and 1/10 hp. on direct current.



MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. "THE *Lo-swing* PEOPLE" SENECA FALLS, NEW YORK

NEW MODEL R *Lo-swing* ON AERO MOTOR CYLINDERS

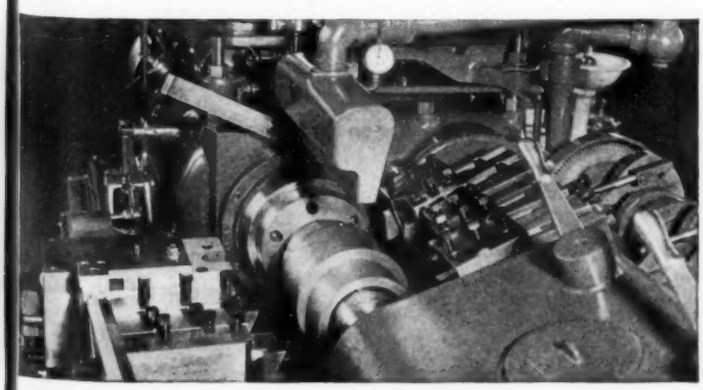


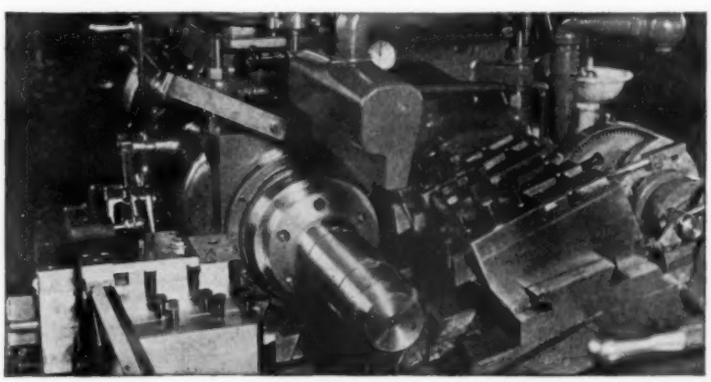
Problem: To rough turn O D, square, and face both ends of aero motor cylinder forging, approximately 8" O D by 11¼" long, with a 5" forged hole.

Solution: The new Model R-14 Lo-swing was selected for this job because of its capacity, power and the rigid tool support inherent in Lo-swing design. The accompanying illustrations clearly show the tooling setup for this job. Four turning tools are mounted on the main carriage and five squaring tools on the Back Attachment. Both turning and squaring are performed simultaneously. About 35 pounds of metal are removed in these operations.

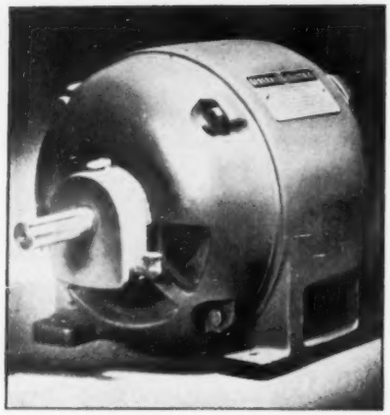
Among the interesting features of this setup is the arbor with six expanding jaws which holds and drives the work. This arbor is fixed to the spindle nose and its outer end supported by the tailstock during the turning operation. In order to expedite loading and unloading of the work without excessive overhang of the tailstock spindle, the entire tailstock is moved longitudinally on the way by an electric motor drive. After the rough work is placed on the arbor, the motor drive moves the tailstock to the forward position in which it is clamped securely to the way. An air cylinder then moves the tailstock quill forward a short distance to support the arbor.

The new Model R-14 Lo-swing illustrated is equipped with the fully mechanical Seneca Falls Quick Change-over Mechanism which makes it possible to change the stroke by merely setting a graduated dial. Easy access to this mechanism is provided through the sliding door on the carriage front.





LATHE NEWS from SENECA FALLS



G.E. "Tri-Clad" Motor Embodies Many Improvements

As a result of a survey of changing requirements of its industrial customers, General Electric Co., Schenectady, N. Y., has developed an entire line of completely new polyphase induction motors, in integral horsepower sizes, to conform with new industrial trends, processes, and practices. Known as the "Tri-Clad" motor and representing one of the most extensive product changes in the history of the company, it features modern streamlined appearance, more complete protection—through the use of a cast-iron frame—than heretofore available except in specially inclosed machines, major advances in the insulation of current-carrying parts, and improved bearing design and lubricating arrangements. At the same time, it incorporates the cast-aluminum rotor, pressure-relief system of greasing for ball bearings, and other proven features.

In place of the conventional open frame, this motor uses a cast-iron box type frame. End shields match the frame and are inclosed above the center line, minimizing contact of vital motor parts with foreign material. "Formex" insulation, dust-tight bearings, and Glyptal in priming and finishing paints armor it against attack of harmful agents. New-type sleeve bearings provide greater life for angle mountings.

Houghton Rust Preventives Utilize New Base Material

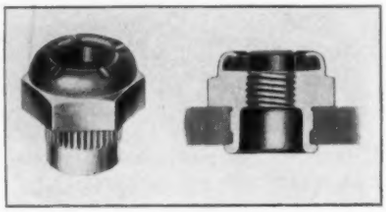
A series of rust preventives, including liquid rust-inhibiting non-drying products, built from a newly developed base has been announced by E. F. Houghton & Co., 240 W. Somerset St., Philadelphia, Pa. This series also includes grease-type (non-drying) products; drying, hard-film products, semi-drying (waxy film) and soluble rust preventives. The new basic material provides a non-crystalline homogeneous film, with a high degree of cohesion and adhesion to metals. It makes a "non-tacky" unbroken film.

Knurled-Shank Clinch Nut Aids in Sheet Metal Work

For fastening sheet-metal assemblies in which the parts must be readily removed and returned to position, a clinch type of self-locking nut with knurled shank is offered by Elastic Stop Nut Corp., 2332 Vauxhall Rd., Union, N. J.

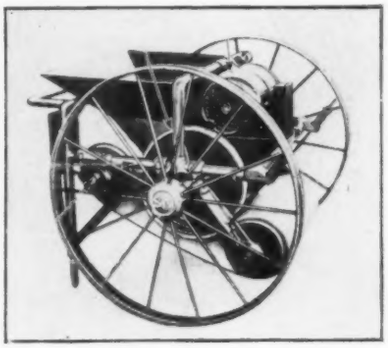
To install the nut, a hole is drilled in the structure and the shank pressed into the hole. The mouth of the shank is then spread against the back of the structure to effect a clinching hold. The knurling engages the drilled surface and assists in eliminating any turning of the nut.

The nut head is fitted with a vulcanized fiber collar which, being unthreaded, resists the entrance of the screw, thus automatically taking up all thread play and bringing the load-carrying thread faces of nut and screw into tight contact. As the screw thread forces its way through the collar, pressure is maintained and increased to such a degree that the screw cannot work loose. Because of the resilient character of the fiber collar, the screw may be removed and replaced repeatedly without loss of locking action.



Materials Loader and Piler Improved by Stephens-Adamson

Three improvements have been made in the loader and piler manufactured by Stephens-Adamson Mfg. Co., Aurora, Ill. First, all loaders are equipped with "Sealmaster" permanently sealed, self-aligning, prelubricated ball bearings for minimum maintenance and maximum power savings. Second, a simplified belt-alignment adjuster works from only one twist with an ordinary wrench. Third, the loader frame has been redesigned for greater strength and improved appearance.



Lewis-Shepard Drum Tipper Fits All Types of Barrels

Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass., has developed a new device for safer handling of barrels and drums. This simple tipper consists of a strong handle with a pronged adjustable collar. This collar allows the tipper to fit all types of drums and large or small-bilged barrels. Its job is to make quick and easy the job of tipping barrels from a horizontal to vertical position or the reverse. Long handle increases the leverage so that less effort is required to handle barrels or drums than when attempted in the ordinary manner.

Wood Soled Safety Shoes Provide Greater Comfort

Increased comfort is provided in the improved Davenport safety shoe offered by F. J. Stahmer Shoe Co., Davenport, Iowa. Specially designed for use where ordinary leather soled safety shoes do not offer sufficient

protection, this shoe has vamps and uppers made of pliable, tough, oiled grain leather. Sole leather is used for counters. Special felt insoles are thicker for added comfort. Wood soles of select close-grained maple have the correct rock from heel to toe for greater ease of walking. Thickness of sole at ball of the foot is 1 in. Heel thickness is $1\frac{3}{4}$ in.

Safety toes in these shoes are available in composition or steel. Composition toe resists pressure up to 600 lb. Steel toe resists pressure up to 4,000 lb.

Cramer Interval Timer Is Dust, Moisture Proof

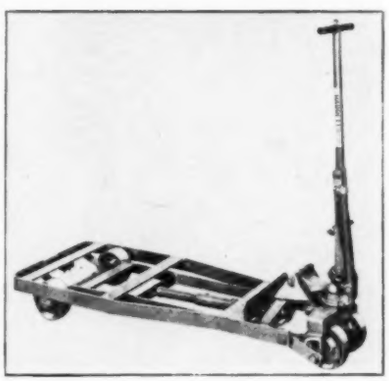
The Model D2 interval timer has been designed by R. W. Cramer Co., Centerbrook, Conn., especially for control of industrial equipment which may be subjected to excessive moisture and dust conditions. A standard self-starting synchronous motor driven interval timer is sealed in a cast aluminum housing arranged for conduit connection and provided with a full vision window and external setting knob. Twelve different scales are available, ranging from

one revolution in 15 seconds to one revolution in 24 hours. Three-inch dials with large characters provide good vision and facilitate accurate setting.

Multiple Stroke Lift Truck Has 2,500 Lb. Capacity

Known as the "Light Boy," the Model GX lift truck introduced by Barrett-Cravens Co., 3255 W. 30th St., Chicago, Ill., has a capacity of 2,500 lb. It has a lift of 3 in., accomplished with either four full or thirteen short strokes. Ball bearing wheels are standard equipment. Front wheels are wide-spread for stability.

This model is made in sizes ranging from 30 to 144 in. long in multiples of 6 in., with either 6, 7, 9 or 11 in. diameter wheels; and in widths of 18 and 24 in.



(advertisement)

Manufacturers Look to Steel Warehouses for Quick Defense Requirements

Many leading manufacturers are relying on nearby steel-service plants for prompt, stock shipment of steel to meet the current surge of business prompted by Washington's defense program.

Probably the leading exponent of "Immediate Steel" is Ryerson with a network of ten strategically-located plants each of which has large and complete stocks of steel and allied products. In addition, each plant is equipped with complete forming and cutting facilities so steel can be prepared to customers' exact requirements. No shop should be without the Ryerson Stock List (see advertisement below).

Thousands of manufacturers report saving considerable time, trouble and money by taking advantage of Ryerson's complete flame cutting service. Modern equipment manned by specially trained operators can quickly burn any shape—no matter how intricate—from carbon or alloy steel plates and billets up to 15" thick.

THE RYERSON UNIQUE 3 point program

1 EVERYTHING IN STEEL

Ryerson carries the largest and most complete steel stocks in America . . . carbon steels, alloys, stainless, etc., in every size, shape and form . . . a ready, reliable source of supply.

2 CERTIFIED QUALITY

Ryerson Certified Uniform High Quality Steels meet exacting, narrow range specifications . . . an important advantage, especially with alloy steels, where chemical content, heat-treating response and other characteristics must be known with certainty to assure best results in less time.

3 IMMEDIATE SHIPMENT

Fast delivery is assured from all ten conveniently located Ryerson plants . . . no order too small for prompt, personal, attention or too large for immediate shipment.

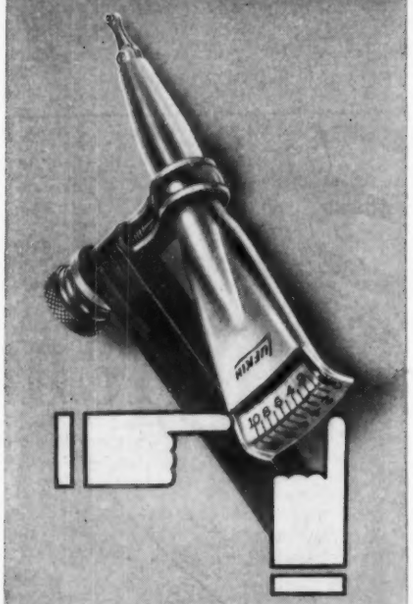
PRODUCTS INCLUDE:
Structurals
Bars
Plates (15 kinds)
Sheets (25 kinds)
Strip Steel
Alloy & Tool Steels
Stainless
Shafting
Mech. Tubing
Boiler Tubes
Welding Rod
Babbitt, Solder
Reinforcing
Nails, Rivets, etc.

RYERSON CERTIFIED STEELS

Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Buffalo, Cleveland, Boston, Philadelphia, Jersey City.

RYERSON *Certified* STEEL·S

LUFKIN
UNIVERSAL INDICATOR



2
READING FACES

And those two reading faces offer just one big reason why the Lufkin Universal Indicator is the outstanding Indicator of the day. No matter how the tool is set, you can take readings without resorting to the use of mirrors or awkward positions. Then, too, the one-piece rotating head both lengthens the tool's life and permits easier, more rapid setting. Your dealer will be glad to give you a demonstration. Write for Catalog.

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TAPES · RULES · PRECISION TOOLS

100-Amp. Pull-Out Control Developed by Cutler-Hammer

A line of 100-amp. pull-out type service control has been announced by Cutler-Hammer, Inc., 205 N. Twelfth St., Milwaukee, Wis. The switch is available with or without branch circuits, being rated at 230 volts a.c. It is also available with two 60-amp. pull-outs; and 4, 6, or 8 plug fuse circuits rated at 115/250 volts.

Features include dead-front construction; bakelite switch base; 3-wire grounded solid neutral; and new type solderless lugs. The device is available in surface or flush mounting types.

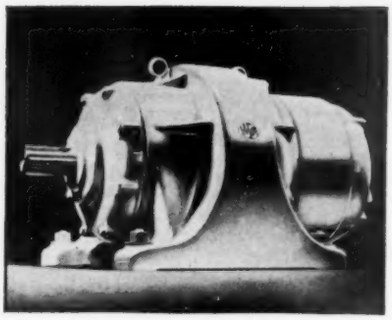
"Vitek" Adjustable Stool Does Not Require Tools

No tools are required to change position of the automatically adjustable "Vitek" stool developed by Dependable Mfg. Co., 122 N. 11th St., Omaha, Nebr. Suitable for laboratories, plants and drafting rooms, this stool is light in weight, and requires only a second to select any desired height. A permanently adjustable locking screw and a foot rest which travels up and down with the seat are among its features.

Browning Oilproof "Gripbelts" Resist Solvents, Acids, Heat

Heat, oil, gasoline and similar agents which deteriorate ordinary rubber V-belts are claimed to have no harmful effect on the oilproof "Gripbelts" developed by Browning Mfg. Co., Maysville, Ky. These belts are also resistant to acids, alkalies and other strong chemicals.

Belts are claimed to contain no rubber, being made entirely from synthetic gums. Although they can generate static, they are claimed to be non-sparking.



Large "Syncrogear" Units Employ Triple Reduction

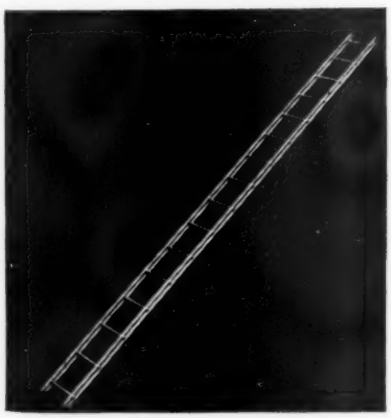
Double and triple reduction geared motors up to 30 hp. at 91 r.p.m. have been added to the "Syncrogear" line offered by U. S. Electrical Motors, Inc., Dept 23, 80 34th St., Brooklyn, N. Y. These units incorporate a pyramidal gear pedestal design to provide ample support to withstand the heavy stresses of high torques.

All castings used in these motors are normalized, assuring permanent alignment of bearings and gears. Both primary and secondary gears dip in a large oil reservoir, providing an ample oil supply to all bearings and gears without submerging any rotating parts.

Straight Aluminum Ladder Weighs Only 1 Lb. per Ft.

A straight aluminum ladder, weighing only 1 lb. per ft. but strong enough for all ordinary uses, has been introduced by Aluminum Ladder Co., 104 Adams St., Tarentum, Pa. Extreme light weight of this ladder permits easy portability and low cost. It is recommended for such purposes as oiling and making general repairs.

Ladder is constructed entirely of 61 S.T. aluminum alloy, having a tensile strength of 48,000 lb. per sq. in. Side rails and ¾-in. round rungs are claimed strong enough to support the heaviest workman. Ladder can be supplied in numerous sizes up to 16 in. wide and 30 ft. long, and may be fitted with safety shoes if desired.



Cathodic Cleaning Compound Made Available by Cowles

Cowles Detergent Co., 10525 Carnegie Ave., Cleveland, Ohio, has announced its MC metal cleaner, which is suitable for still tank work and which is highly recommended for cathodic cleaning of steel, brass and copper. This cleaner is a medium pH material of unique anionic balance, containing an effective detergent accelerator. It is readily soluble, cleans fast and rinses rapidly. It is claimed to be economical to use because it is technically anhydrous in composition; thus chemically clean metal can be obtained by using low concentrations.

Bronze Globe Valve Designed for Throttling

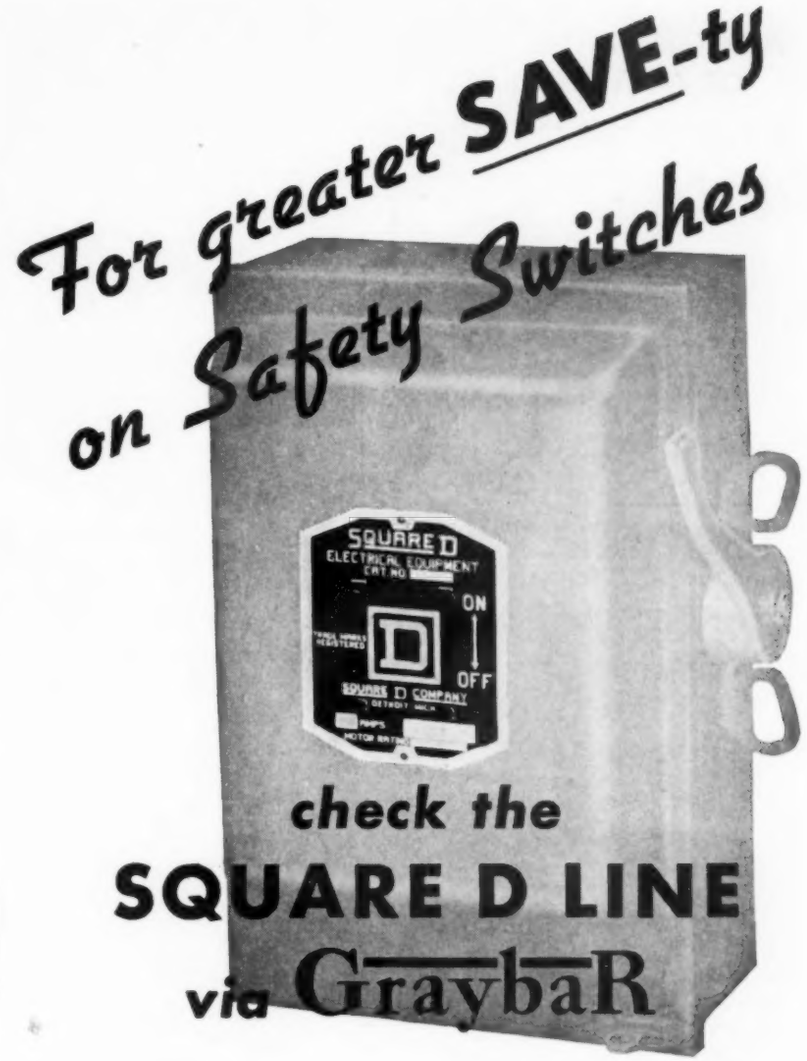
The Fig. 531-P bronze globe valve made by Reading-Pratt & Cady Div., American Chain & Cable Co., Reading, Pa., has a full-plug type seat and

disk, and is designed for throttling service on high-temperature, high-pressure steam lines. It is also suitable for use on high-pressure lines carrying boiler scale and other gritty substances which quickly wear ordinary seating materials. Body of this valve is of special hard bronze. Disk and seat are of stainless steel of 500 Brinell hardness. Stem is of high-strength wear-resisting bronze.

Resistance Forge Welding Aided by Special Timer

The recently announced resistance forge welding process which permits spot welding of heavy iron and steel sections and which requires a complicated sequence of accurately timed operations is made possible through a specially designed electronic welding timer developed and built by Weltronic Corp., 2832 E. Grand Blvd., Detroit, Mich.

This timer provides accurate control for the various operating sequences required for the process which are: low weld current; high



Save-ty and safety go hand in hand when you turn to the Square D line of enclosed industrial switches. A full range of types and capacities meets every requirement for motor disconnects, sectional disconnects in factories, disconnects on industrial furnaces, and the like. It was Square D, remember, which developed such features as unit base construction, multi-spring jaws, high-speed break, positive pressure fuse clips, arc suppressors, keyed interlock.

The Square D "Type A" Safety Switch meets rigorous needs for heavy duty industrial service. "Type C" meets all intermediate service demands. Both are promptly available via GRAYBAR in the size and type you require. Write GRAYBAR today for catalog giving complete mechanical and electrical specifications.

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GraybaR QUALITY Since 1869 *Everything Electrical* GraybaR ELECTRIC COMPANY

ARMOR PLATE OR MATCH PLATE . . . IT'S ALL THE SAME TO A DoALL

FIRST AID TO OUR *DEFENSE* PROGRAM

Top illustration shows a DoAll cutting out holes on flask dowels in aluminum match plate for metal patterns.

In the circle armor plate is being cut at the rate of 40 square inches per hour.

FASTEST PRECISION METHOD

For cutting internal and external shapes from any metal up to 10" thick. DoAll replaces shaping, milling and lathe work with enormous savings of time, labor and material.

In designing DoAll Defense Tools, DoAll engineers use this big board with drafting machine on an overhead crane.

Let a factory trained man bring a DoAll to your plant and show you what it can save you.

FREE *Handbook on Contour Machining, 158 pages of valuable metal working helps.*

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1310 S. Washington Ave., Minneapolis, Minn.

☐ Send data on the DoAll AM-12
☐ Send free Handbook

Name .....

Address .....

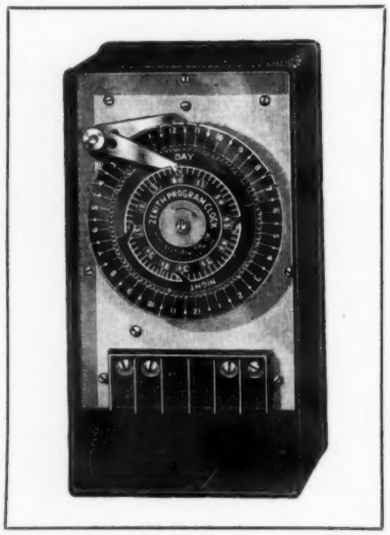
weld current; initial (low) welding pressure; impact forging (high) pressure; cool time; hold time. In addition, the device times virtually any combination of functions required in spot welding heavy sections within the scope of the resistance forge welding process, and can be used with any equipment capable of handling such work, whether standard or special.

Automatic operation of the Model 79 timer eliminates the necessity for skill on the part of the operator, even though fabrication of heavy sections is required at speeds which compare favorably with those of spot welding sheet metal.

Zenith Program Clocks Operate Signals Often

Signals can be operated in any five minute period with the Type P 512 and at any one minute period with the Type PD 124 synchronous program clocks made by the Zenith Electric Co., 845 S. Wabash Ave., Chicago, Ill. These clocks have a large 24-hour dial and a one-hour dial cam. Pointers connected to a contact arm ride the dials and permit the contact arm to fall only when preset time is reached.

These units are operated by heavy duty synchronous motors, with contact arrangements such that accuracy is assured. Contact can be so arranged as to operate a signal either in one ring or a coded ring, or for a definite time from 2 to 6 seconds.

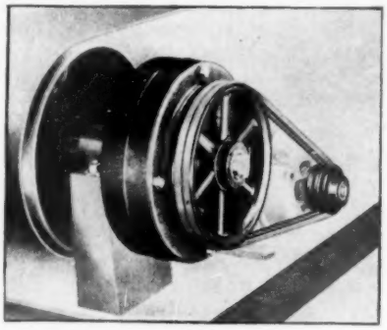


100-Watt Fluorescent Lamps Offered by Hygrade Sylvania

Hygrade Sylvania Corp., Salem, Mass., has developed the "Miralume" F-230 fluorescent lighting fixture to incorporate the new 100-watt Hygrade fluorescent lamps. This fixture comes complete with two 100-watt lamps, each 5 ft. long, completely wired and ready for use.

"American" Speed Reducers All Have 13:1 Ratio

Only five reduction units, each with a 13:1 ratio, are claimed by American Pulley Co., Philadelphia, Pa., to cover all applications from ½ to 30 hp. and to provide any desired speed between 11 and 215 r.p.m. with standard equipment. In addition to these helical gear reduction units which are mounted directly on the shaft of



the driven machine, a standard belt drive between the motor and the input shaft of the reduction unit is used to vary ratios from the 13:1 of the gear reducer. Since the gear reduction unit mounts directly on the shaft as easily as the conventional pulley, no additional space is required.

NEW MATERIALS

New Grade of "Kennametal" Is 15 Per Cent Stronger

A straight tungsten carbide which is claimed to be approximately 15 per cent stronger than any other tungsten carbide of the same hardness has been placed on the market by McKenna Metals Co., 103 Lloyd Ave., Latrobe, Pa. Known as "Kennametal" Grade K4, this carbide tool material has a hardness of 92.0 Rockwell A and strength of 223,000 lb. per sq. in. (transverse rupture test). Due to its high thermal conductivity, together with its unusually high wear resistance, it is particularly applicable to machining hard, crumbly materials such as cast iron, Bakelite, porcelain, hard rubber, glass, casein, silicon aluminum, hard bronze and other non-ferrous materials. The increased strength of Grade K4 is particularly desirable when taking rough cuts or interrupted cuts on hard metals.

Jessop Aircraft Steels Include Bar Products

Jessop Steel Co., 595 Green St., Washington, Pa., has announced that its production of special alloy steels for the aircraft industry has been ex-

tended to include heat-treated and cold-drawn annealed bar products. Manufacture of Jessop aircraft steels was formerly confined to sheets and plates.

S.A.E. steels of the various alloy series, such as 2300, X4130, and 4340, are now supplied in bar form to meet the physical requirements for such parts as bolts, U-bolts, studs and other stressed parts. They are available in the principal analyses required. All such steels are melted in electric furnaces, rolled to close tolerances, and Magnaflux tested to meet requirements of Government specifications for aircraft.

Lincoln "Planeweld" Electrode Suitable for Aircraft Welding

Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio, has developed the "Planeweld" arc welding electrode especially for welding SAE-4130 and X-4130 chrome molybdenum steels, which are widely used in airplane construction. This electrode is suitable for welding in all positions, and when used on steels of the types mentioned provides weld metal with physical properties similar to the metal welded. Its welds are smooth without undercutting. There is minimum spatter and good crater conditions. Welds made by the electrode on such steels respond to heat-treatment quite similarly to the parent metal.

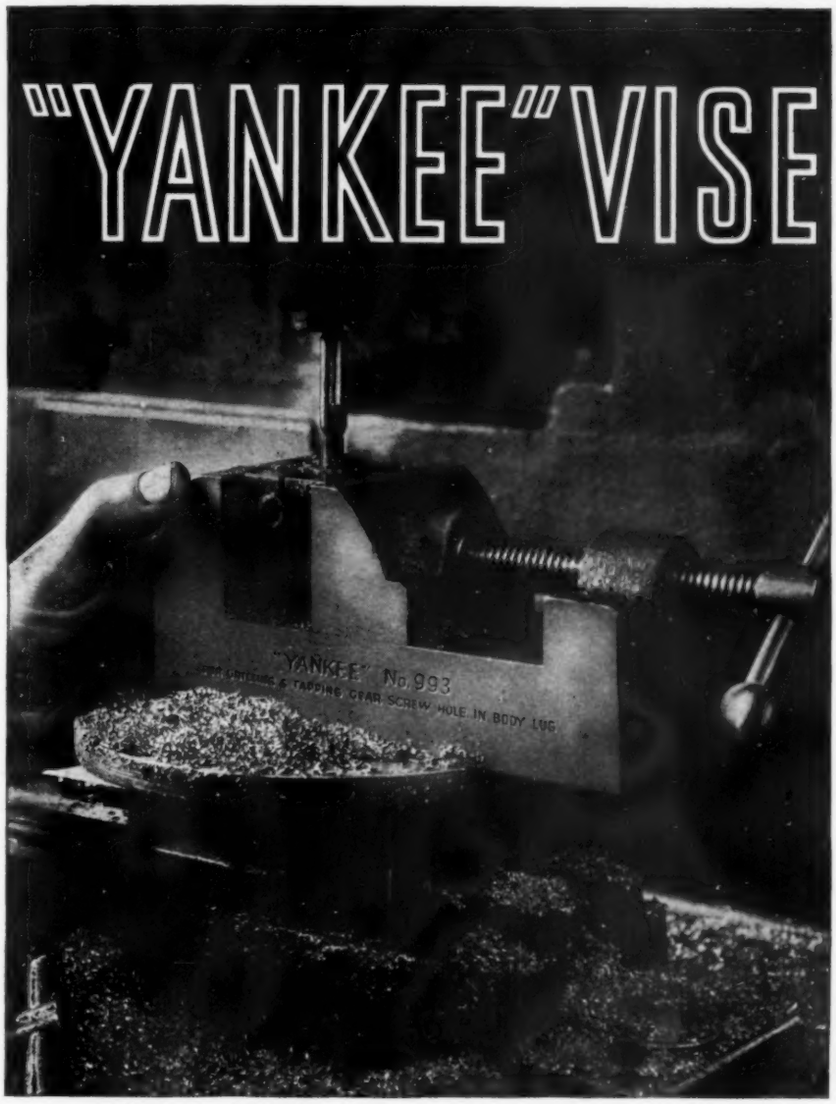
"Planeweld" comes in two types, No. 1 for material 0.120 in. thick and heavier, and No. 2 for light gage airplane parts and airplane tubing. The electrode is available in four sizes: No. 1 in $\frac{1}{8}$ and $\frac{5}{32}$ in., and No. 2 in $\frac{1}{16}$ and $\frac{3}{32}$ in.

"Speed Case" Steel Has Free-Machining Properties

Speed Case Plate Div., of W. J. Holliday & Co., Hammond, Ind., has developed "Speed Case" low-carbon open hearth steel plate for use where free machining properties are essential. This material, it is said, can be machined without tearing and without the use of cutting oils.

Capable of being machined at speeds up to 250 surface ft. per min., "Speed Case" is said to be ductile, resistant to impact and abrasion. Physical properties include tensile strength up to 72,000 lb. per sq. in. Plate 4 in. thick shows Brinell hardness from 141 to 156.

The material derives its name from the fact that it can be carburized in a fraction of the time usually required by similar steels. Penetration is deep, with a uniform case of from 62 to 66 Rockwell C, combined with a tough core that averages from 15 to 27 Rockwell C. The metal is recommended for forging, cold forming, pressing, as well as for machining. It can be readily welded.



"YANKEE" VISE No. 993 CONVERTED INTO DRILLING AND TAPPING JIG

For accuracy and speed in handling—add "Yankee" Vises to your shop equipment. Accurately machined—sides, ends and base, the "Yankee" Vise holds work square on face plate or machine bed. Vise illustrated at right, made in four sizes: No. 991; 1½" jaw width. No. 992; 2" jaw width. No. 993; 2¾" jaw width. No. 994; 4" jaw width. "Yankee" Vise also available with removable swivel base. Sizes: Nos. 1991, 1992, 1993 and 1994.

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TRADE PUBLICATIONS

AUXILIARY RELAYS A four-page illustrated booklet containing descriptive, construction, and electrical and mechanical data on auxiliary control relays is being circulated by Department 7-N-20, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

CIRCUIT BREAKER Bulletin No. GEA-2164A, circulated by General Electric Co., Schenectady, N. Y., describes the construction and operating advantages of circuit breakers operated in oil.

DIES A four-page illustrated booklet, No. 11, Meehanite, the Metal for Cast-to-Form Dies," includes a table of properties available in Meehanite dies as well as a variety of applications and performance records.

ELEVATORS & CONVEYORS C. O. Bartlett & Snow Co., Cleveland, Ohio, is distributing a new general catalog, No. 90, which gives complete details of elevators and conveyors, chains and sprockets, crushers, gates and miscellaneous equipment.

MATERIAL-HANDLING The Industrial Truck Statistical Association, 208 S. La Salle St., Chicago, Ill., has published a practical guide for the systematic study of material handling and the correct application and use of power industrial trucks under the title "Material-Handling Handbook" based largely on the composite experience of American industrial companies. Various practical operating hints covering routing, dispatching, arrangement of aisles, and other problems of material-handling are presented. All sections of the handbook are applicable to any industry and any plant, whether large or small. Copies are being distributed free to those actually engaged in material-handling work, or to general executives concerned in the economics of handling. To others a nominal charge will be made to cover cost of printing and mailing.

PRESSURE FILTERS Bulletin No. W-210-B26, circulated by Worthington Pump & Machinery Corp., Harrison, N. J., provides descriptive material regarding pressure filters for water purification. Bulletin No. W-210-B-27 describes the construction and operation of a hot process water softener for boiler feed water purification.

PROTECTIVE PAINTS American Marietta Co., Chicago, Ill., is circulating a maintenance painting handbook which aids in the proper selection of paints for surface protection.

SWITCHES Center & Giveen Co., Berkeley, Calif. has issued a two-page leaflet which describes the application, range, contacts and construction of an automatic pressure switch.

TIME SWITCHES Bulletin No. GEA-2963B, circulated by General Electric Co., Schenectady, N. Y., provides information concerning the advantages and applications of time switches.

VALVES Eaton Mfg. Co., Detroit, Mich., has issued a four-page folder which describes the laboratory testing of valves.

VISES Wesson Co., Detroit, Mich., has issued a four-page folder which illustrates the operation of all steel vises. Prices and sizes are included.

WELDER DATA A four-page folder published by the Pier Equipment Manufacturing Co., Benton Harbor, Mich., offers information on the manually-operated type and on the automatic type welders. A brief description containing the applications of the various sizes made which run up to 50 KVA is also included.

NEW BOOKS

VALUES OF PSYCHOLOGY IN INDUSTRIAL MANAGEMENT—*Personnel Series Booklet No. 43, published by American Management Association, 330 W. 42nd St., New York, N. Y. $0.50.*

Containing 36 pages, this booklet includes sections by Bruce V. Moore, Pennsylvania State College, Harold C. Taylor, Western Electric Co., and Edward N. Hay, personnel officer of the Pennsylvania Co. Mr. Moore discusses several ways in which psychology can help industry, Mr. Taylor outlines a test program for an industrial company, while Mr. Hay discusses the problem of inaugurating a test program.

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CONCILIATION AND COOPERATION IN COLLECTIVE BARGAINING — *Personnel Series Booklet No. 44, published by American Management Association, 330 W. 42nd St., New York, N. Y. $0.75.*

Comprising 48 pages of discussion, questions and answers, this booklet contains sections by Phillips L. Garman, director of research, International Printing Pressmen & Assistants' Union of North America; John R. Steelman, director, United States Conciliation Service; Merrill Shepard, Pope & Ballard; and G. L. Patterson, thirteenth regional director, National Labor Relations Board. Entitled "How Organized Labor Can Cooperate with Management," the section by Mr. Garman discusses types of labor leadership, the importance of the foremen's attitude and requisites

for union cooperation. Also treated are arbitration agreement procedures, technical trade schools, and other phases of the cooperation problem. "Conciliation Experience in the Prevention of Conflict," by Mr. Steelman, analyzes the functions of conciliation service, gives the backgrounds of commissioners and outlines conciliation procedures. Mr. Shepard, in "Keeping Up to Date on the N.L.R.A.," discusses recent interpretations of the act. In "Problems and Procedures Under the N.L.R.B.," Mr. Patterson reviews employer and employee rights under the act and outlines its operation.

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EMPLOYEE RELATIONS POLICIES: HOW TO MAKE THEM SPECIFIC—*Personnel Series Booklet No. 40, published by American Management Association, 330 W. 42nd St., New York, N. Y. $0.50.*

Written by G. B. Hattersley, vice-president in charge of operations for Sears, Roebuck & Company, this 22-page booklet outlines how an operating executive should collaborate with the personnel department in establishing policies. It also discusses ways in which he can induce field executives to make these policies specific. Beginning with a background of employee relations traditions, the booklet discusses profit-sharing pension funds, presidents' reports to employees, and advantages of a strong personnel department. The major portion of the work is devoted to a discussion of joint personnel responsibility and field checks of policies, with several specific rules to facilitate carrying out a program.

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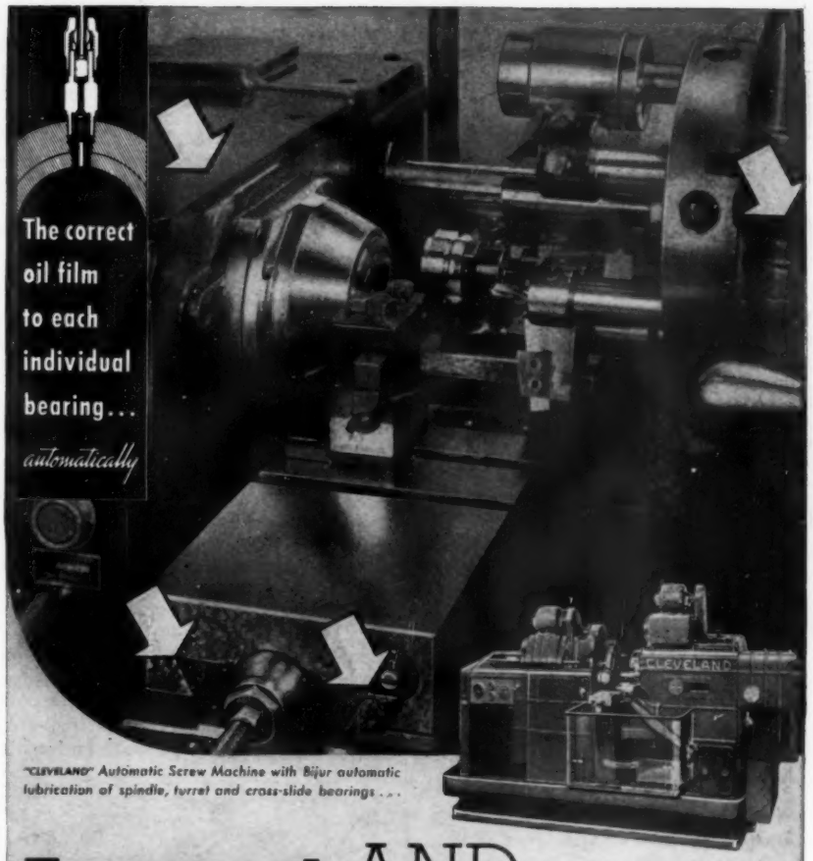
ENGINEERING DRAWING PROBLEMS. *By Frederic G. Higbee, Sr., M.E., professor and head of the department of engineering drawing, University of Iowa; and John M. Russ, M.S., associate professor in the department of engineering drawing, University of Iowa. John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. $2.25.*

This 9 x 11-in. loose-leaf book presents 114 problems of the completion type, ranging from simple lettering exercises to complicated parts and assembly detail drawings. The complete type of problem is intended to provide a ready means of providing drafting experience in many principles of graphical representation often overlooked. The authors call attention to the fact that, while all important principles and conventions of the graphical language are illustrated, the problems alone do not constitute a course in engineering drawing. The problems are intended to be supplemented by considerable additional work; in fact, the book has been designed to be used with a textbook on engineering drawing.

The ring-type binding of this book



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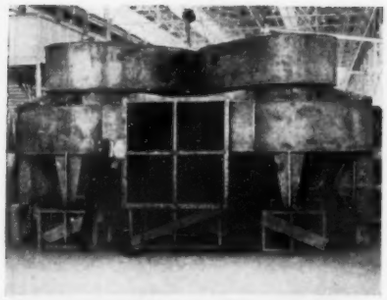

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should make it especially handy when opened at any page. Each page is perforated so that it may be torn out easily, and is also provided with three additional holes so that it may be kept in any standard loose-leaf notebook. Several sheets of blank drawing paper are included, as are a number of sheets of tracing paper.

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LABOR ECONOMICS IN A PERIOD OF CHANGE.—*Personnel Series Booklet No. 41, published by American Management Association, 330 W. 42nd St., New York, N. Y. $0.25.*

What is the economic problem that confronts America today? Is it a problem of guarding against a war boom and a war inflation? Or is it a problem of stimulating recovery and accelerating the absorption of 8,000,000 unemployed? Should we step on the brake or on the accelerator? These and other pertinent questions are answered in this 12-page booklet by Sumner H. Slichter, professor of business economics of Harvard University. The greater part of the discussion is taken up with planning for post-war demands and with analyses of various means for providing a cushion against a post-war slump.

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PRACTICAL TECHNIQUES OF INDUSTRIAL TRAINING—*Personnel Series Booklet No. 42, published by American Management Association, 330 W. 42nd St., New York, N. Y. $0.50.*

Containing sections by L. D. McDonald, vice-president, Warner & Swasey Co.; Frederick E. Searle, superintendent, Henry Ford Trade School; and R. D. Hayes, assistant director of personnel relations, American Rolling Mill Co., this 28-page booklet discusses many phases of the training problem, from the selection of apprentices to the teaching of foremen. The section by Mr. McDonald deals with adapting training courses to meet present special needs, that by Mr. Searle discusses methods for preparing high-school graduates and others for skilled work in industry, while that by Mr. Hayes analyzes methods of teaching foremen how to teach.

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TECHNICAL DRAFTING.—*By Charles H. Schumann, associate professor and executive officer, Department of Drafting, Columbia University. 793 pages. Published by Harper & Bros., 49 E. 33rd St., New York, N. Y. $3.50.*

This book offers one of the most comprehensive and thorough treatments of the various aspects of engineering drawing yet compiled in a single volume. The first part presents elementary principles of the subject, including several topics not hitherto treated in a textbook. Many new problems are provided for the various chapters. The second part represents more advanced work, going intensively into commercial practices followed in various branches of engineering, including welding, construction, architectural drafting, topographical drafting, as well as the more usual branches. Each chapter provides many projects of the same nature as those encountered in engineering drafting rooms, and the problems are designed to be similar to those confronted by professional draftsmen. An unusually large number of illustrations is included in the text.

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NEW RESPONSIBILITIES OF THE PERSONNEL EXECUTIVE—*Personnel Series Booklet No. 45 published by American Management Association, 330 W. 42nd St., New York, N. Y. $0.50.*

This 32-page booklet contains sections by J. Walter Dietz, personnel relations manager of Western Electric Company; W. A. Patterson, president of United Air Lines; Harold F. North, industrial relations manager, Swift & Company, and R. R. Zimmerman, council of personnel administration, United States Government. In a section entitled "This Thing Called Personnel Relations," Mr. Dietz traces the development of personnel relations and personnel organization from 1910 to the present time. He also analyzes present human research activities and discusses possible future trends. In "Top Management Views the Personnel Job," Mr. Patterson conceives the approach as being one of avoiding obsolescence in employees. He also discusses fallacious personnel methods, and tells of ways which his company has found to maintain employee confidence. Mr. North in "The Personnel Man's Functional Relationships" reminds employers of employees' rights and privileges, and tells of methods for eliminating grievance causes. In a section headed "In-Service Training for the Personnel Job," Mr. Zimmerman analyzes the requirements and qualifications of personnel men and discusses effective training methods.

Correction—Pressures and Blanks for Press Work

Through the courtesy of the Cincinnati Shaper Company, a recently published Reference Book Sheet (*AM*—Vol. 84, pages 933 and 935), gave tonnages for bending sheet metal with "air bend" dies. The fourth paragraph on page 933 stated "The pressure required varies directly as the metal thickness." This statement is incorrect and should read "The pressure required varies approximately directly as the square of the metal thickness."